PRELIMINARY DRAFT

CITY OF TUCSON

AVRA VALLEY HABITAT CONSERVATION PLAN

Prepared by

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Section 1

INTRODUCTION AND BACKGROUND

This Preliminary Draft Avra Valley Habitat Conservation Plan (HCP) has been prepared in support of the City of Tucson’s (City’s) application for an Incidental Take Permit (Permit) in conformance with Section 10 of the Federal Endangered Species Act of 1973 (ESA). Through this HCP, the City is committing to implement certain actions that will minimize and mitigate the impacts of any take of certain specified species that could occur as a result of future Tucson Water Department water supply projects and associated capital improvement projects (CIPs). It is anticipated that the permit length will be approximately 50 years. The HCP addresses proposed development activities on specified City of Tucson owned lands in Avra Valley.

The need for an HCP for this planning area is driven by the anticipation of future activities in these areas that will have impacts on endangered species and/or their habitats. The Avra Valley planning area includes parcels of land that may be developed for future water resources projects.

1.1 Background

Tucson is located in southeastern Arizona (Figure 1.1-1). Portions of the City-owned lands in Avra Valley support lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), a species currently listed as endangered (62 FR 10730 and 58 FR 49875) under the ESA. Until the species was delisted effective May 15, 2006, cactus ferruginous pygmy-owl (CFPO, *Glaucidium brasilianum cactorum*) Proposed Critical Habitat (68 FR 22353) was located within portions of the Avra Valley planning area.

The City has been experiencing significant population growth over the past few decades. According to unofficial population data from the Pima Association of Governments, in 1980, Tucson encompassed 98.84 square miles and supported 330,537 residents (Pima Association of Governments 2007). Between 1980 and 1990, the City’s population increased by 74,853 residents (23 percent). From 1990 to 2000, the significant population growth continued, with an increase to 486,699 residents (20 percent change). This population growth has been accompanied by an increase in the incorporated area of the City. 2007 data indicate that Tucson encompasses about 227.62 square miles and supports 541,132 residents. Population projections for the next 50 years suggest that the City’s population could reach 1,124,727 within a boundary of 313.81 square miles by 2058 (Pima Association of Governments 2007). In the future, residents will likely rely on Avra Valley for water resources.

The Avra Valley HCP planning area encompasses various City-owned parcels in Avra Valley, which are shown in Figure 1.1-2. The Avra Valley planning area consists of 19,821 acres in unincorporated Pima County (the County), west of the Tucson Mountains. Most of these parcels have been disturbed by past agricultural activities, including irrigated farming that occurred before their purchase by the City. Vegetation communities include upland and riparian communities, both of which have been extensively modified by human activities. Upland vegetation communities on the City-owned properties include Scrub Grassland, Sonoran Desertscrub, and Sonoran Vacant or Fallow Land. Riparian vegetation communities include Sonoran Desertscrub Xeroriparian, Sonoran Riparian Deciduous Forest and Woodland (both mesquite and cottonwood-willow series), and Sonoran Deciduous Riparian Scrub.

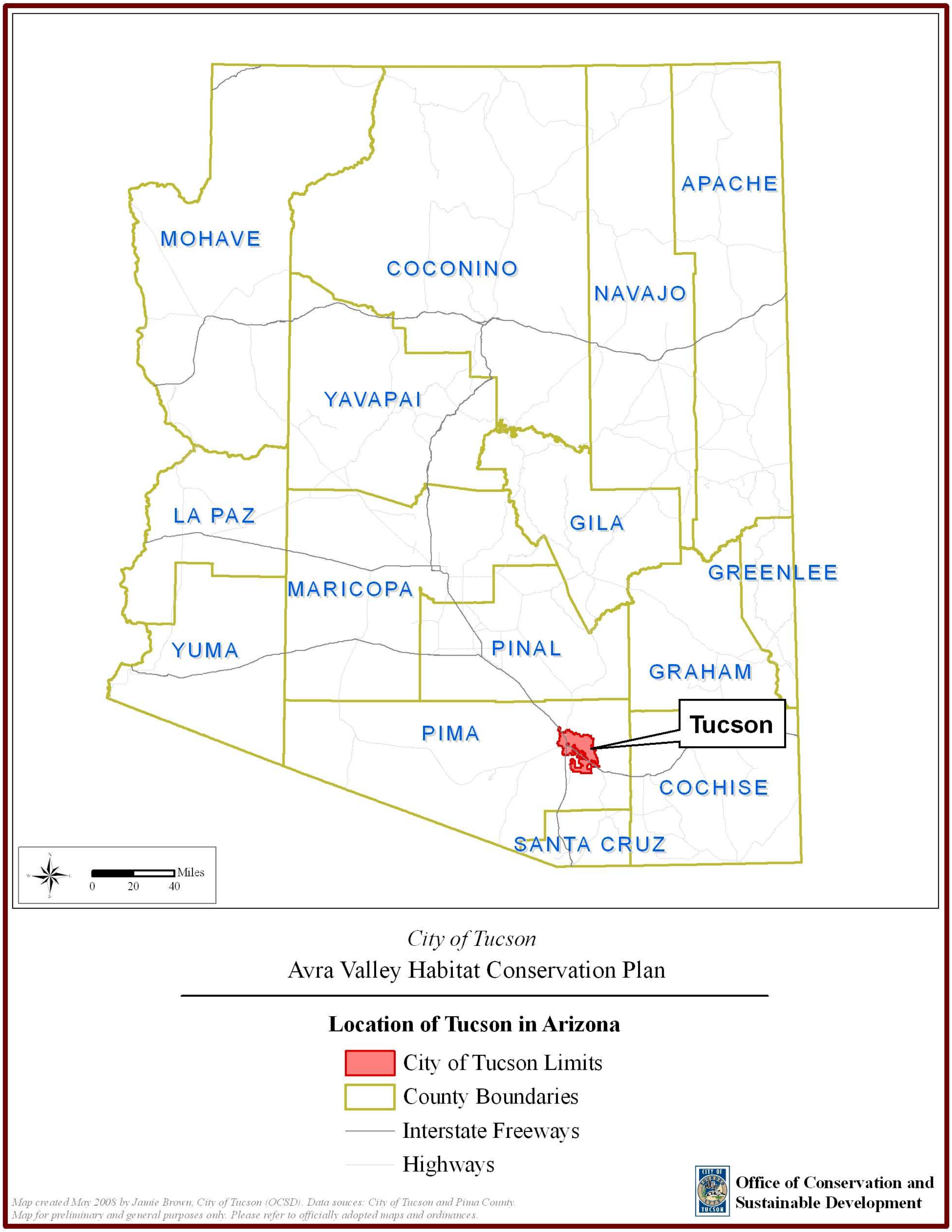

Figure 1.1-1. Location of Tucson in Arizona.

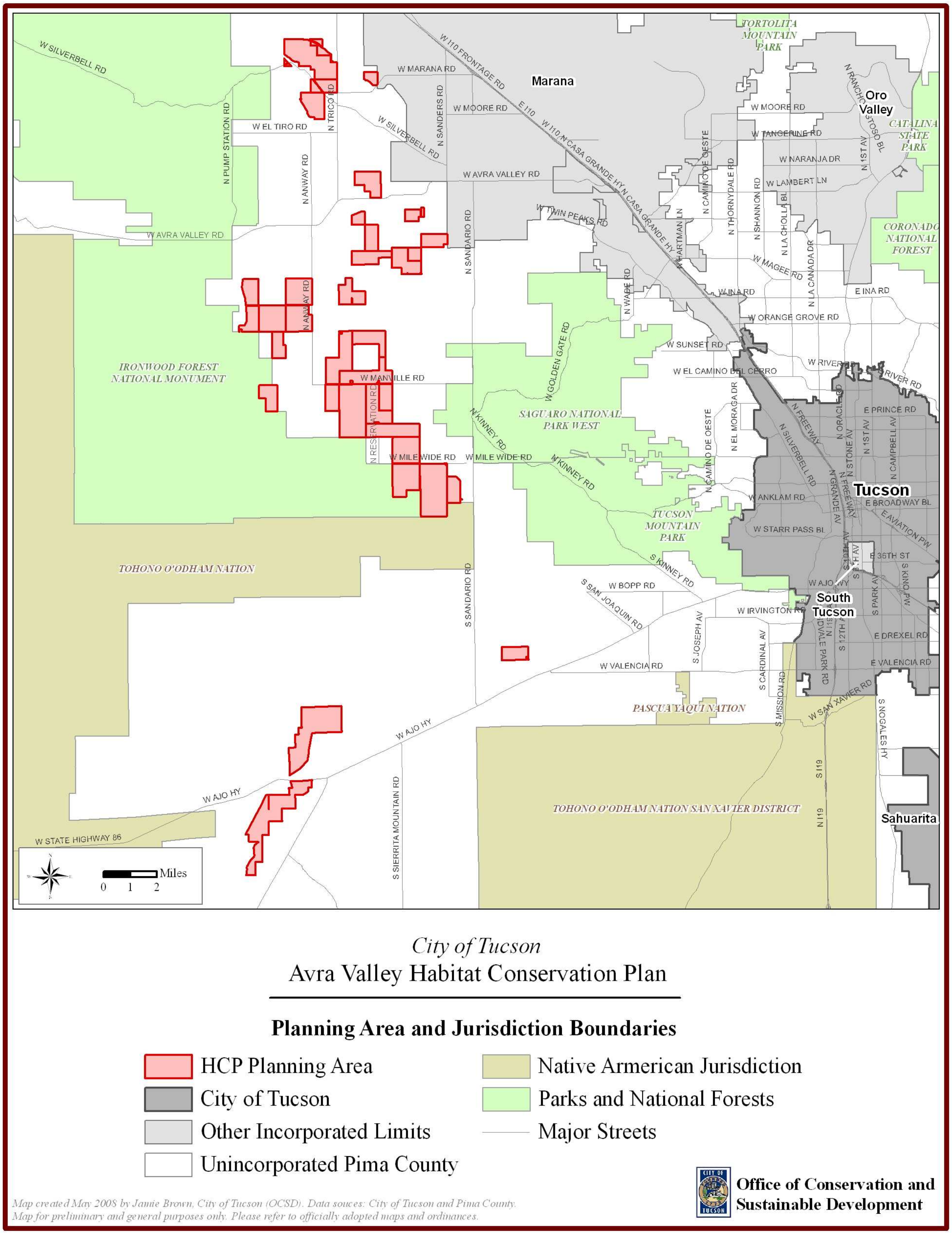

Figure 1.1-2. City of Tucson Avra Valley Habitat Conservation Plan Avra Valley planning area.

Through this HCP, the City aims to promote conservation of natural resources while providing water security for future growth. The City seeks to accomplish the following objectives with this HCP:

- Facilitate compliance with the ESA for Tucson Water Department water supply projects and associated capital improvement projects (CIPs);
- Promote achievement of regional economic objectives including the orderly and efficient development of certain lands, while recognizing property rights, and legal and physical land use constraints;
- Complement other regional conservation planning efforts such as Pima County's (County's) Sonoran Desert Conservation Plan (SDCP) and the Town of Marana HCP project.

The Town of Marana (Marana) initiated an HCP process in late 2002, continuing through September 2004. During this process, the Stakeholder Working Group and the Technical Biology Team identified six species for coverage, which includes all of the City's Avra Valley HCP Covered Species. After the planning process slowed due to staffing issues, Marana re-convened both the Stakeholder Working Group and the Technical Biology Team in January 2007. An internal draft HCP was produced in October 2007, with a publicly available version scheduled for release in December 2008. Marana's goal is to submit a Final Draft HCP to the U.S. Fish and Wildlife Service (USFWS) in May 2009 along with an application for a Section 10 permit (Town of Marana 2008).

Portions of the Avra Valley HCP Planning Area are in close proximity to Marana's jurisdictional limits. Four farms—Chu, Gin, Glover, and Martin—are within one mile of Marana, while both the Chu and Martin Farms are immediately adjacent. Given the proximity and the overlap in HCP Covered Species between Marana and the City, finding ways to complement these planning efforts may more effectively and efficiently achieve the aims of the individual HCPs.

Another important consideration in the long-term success of the Tucson HCP is the presence of buffelgrass (*Pennisetum ciliare*) in the City HCP Avra Valley planning area. Buffelgrass, a drought-tolerant, perennial forage grass, was introduced into the Southwest from Africa in the late 19th century. It arrived in Tucson shortly before 1940 (County 2006). Since that time it has spread rapidly in eastern Pima County, and is now abundant on Tumamoc Hill, the Tucson Mountains, Saguaro National Park, and Organ Pipe Cactus National Monument (OPCNM). It has also become established along roadsides, especially where runoff rainwater collects.

Buffelgrass poses a significant threat to the biodiversity of the Sonoran Desert region, not only because it can out-compete and displace native plant species, but also because it strongly modifies the communities it invades (The Nature Conservancy [TNC] 2002). Buffelgrass re-sprouts vigorously after fire, thus is capable of causing more frequent and larger wildfires, decreasing both water infiltration to the soil and changing the way essential plant nutrients cycle in the desert (U.S. Geological Service [USGS] 2002). Recurrent fires maintain buffelgrass populations, and the ecological result is the conversion of native desertscrub communities to African-type grassland with reduced biological diversity (TNC 2002). Native, long-lived plant species (e.g., saguaro [*Carnegiea gigantea*], ocotillo [*Fouquieria splendens*], and *Opuntia* cacti) are not adapted to these frequent fire cycles. In OPCNM, studies have determined that buffelgrass excludes native shrubs such as creosote bush (*Larrea tridentata*), saltbush (*Atriplex* sp.), bursage (*Ambrosia* sp.), and associated native grasses and forbs (TNC 2002). In addition to its effects on native plants, buffelgrass also can alter animal community structure (USGS 2002). For example, buffelgrass can reduce the open space required for some animals, such as lizards, to escape predators, which can lead to shifts in wildlife population abundance and species diversity. A map depicting buffelgrass occurrences in the vicinity of the Avra Valley HCP is provided as Figure 1.1-3.

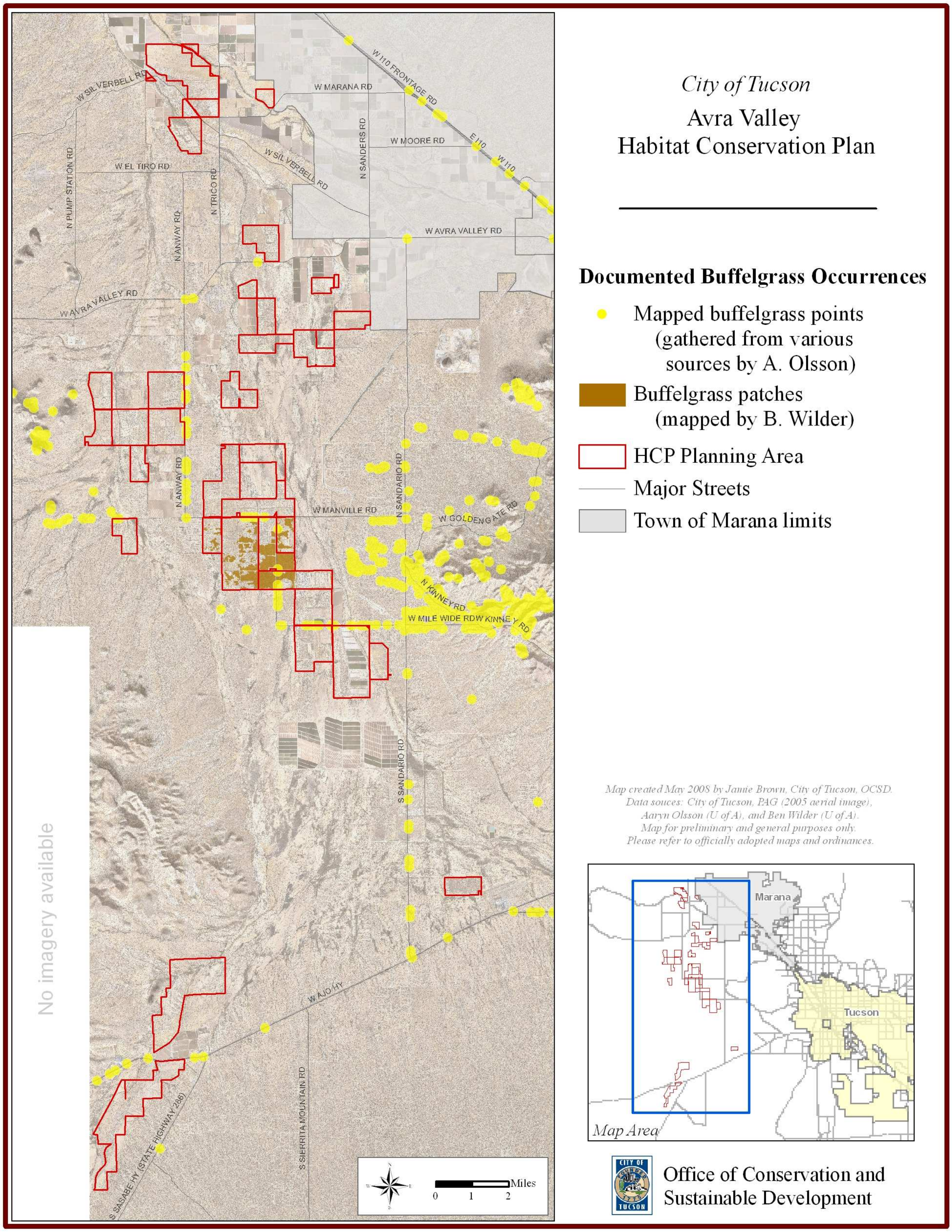

Figure 1.1-3. Documented buffelgrass occurrences in the vicinity of the HCP planning area.

There is no single approach to the successful control of buffelgrass in large areas (TNC 2002). For large infestations, management will likely be most effective through an integrated management approach. This includes removing standing biomass by application of herbicides, continued spraying of herbicides to control new seedlings or re-sprouts, followed by active restoration to create dense native vegetation. For small areas, control in disturbed, low-nutrient areas has been accomplished successfully by carefully pulling or digging out entire plants, followed in the second year, or in later years, by the pulling of new seedlings. There are no known biological controls of buffelgrass. In order to manage the infestation and spread of buffelgrass in the Avra Valley HCP Planning Area, Tucson Water Department (hereinafter "Tucson Water") staff been active participants in regionwide buffelgrass management discussions. Chapter 5 describes Tucson Water's efforts in more detail.

1.2 Permit Holder and Permit Duration

The City will be the HCP permit holder and will be solely responsible for ensuring implementation of the HCP measures. The HCP addresses proposed Tucson Water water supply projects in the Avra Valley planning area that are projected through 2050, as described in the City's Tucson Water "Water Plan: 2000–2050" (City Water Plan) and associated capital improvement projects (CIPs) (City of Tucson Water Department 2004). Based on Tucson Water's proposed timeline for these possible projects, the permit length will be approximately 50 years.

1.3 Permit Area

The City HCP permit area includes 19,821 acres in the Avra Valley planning area. Figure 1.1-2 shows the HCP planning area relative to the incorporated portion of the City. The permit area is a collection of former farmland that was purchased by the City of Tucson in the 1970s and 1980s to acquire the water rights, and thereby, allow the City to use the water for municipal supply purposes (City of Tucson Water Department 2004). Nearly 90 parcels as part of thirty-two former farms comprise the planning area. For clarity and simplicity sake as part of the HCP process, parcels have been merged by farm name as shown in figure 1.3-1. Areas where mitigation lands may be located are identified in the conservation program as are acreages associated with each former farm. (Section 5). In the City's Preliminary Draft HCP of 2006 (City of Tucson 2006), the Avra Valley planning did not include the Trust 205 property because it was not anticipated to be used for development. The property has since been added to the planning area. Also, parcels that compose the Southern Avra Valley Storage and Recovery Project (SAVSARP) were originally included in the planning area. As Tucson Water is engaged in a separate ESA Section 7 consultation for these parcels, they have been removed from the planning area.

1.4 Species to Be Covered by Permit

The Avra Valley HCP covers the seven species listed in Table 1.4-1. These species, referred to as "covered species," will be included in the Permit if it is issued.

Table 1.4-1. Species Included in the City Avra Valley Habitat Conservation Plan

Species	Federal Status
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	Endangered
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	Delisted May 15, 2006, status pending
Western burrowing owl (*Athene cunicularia*)	Species of Concern
Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*)	Petitioned
Ground snake (valley form) (*Sonora semiannulata*)	None
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	Species of Concern
Western yellow-billed cuckoo *(Coccyzus americanus occidentalis)*	Candidate

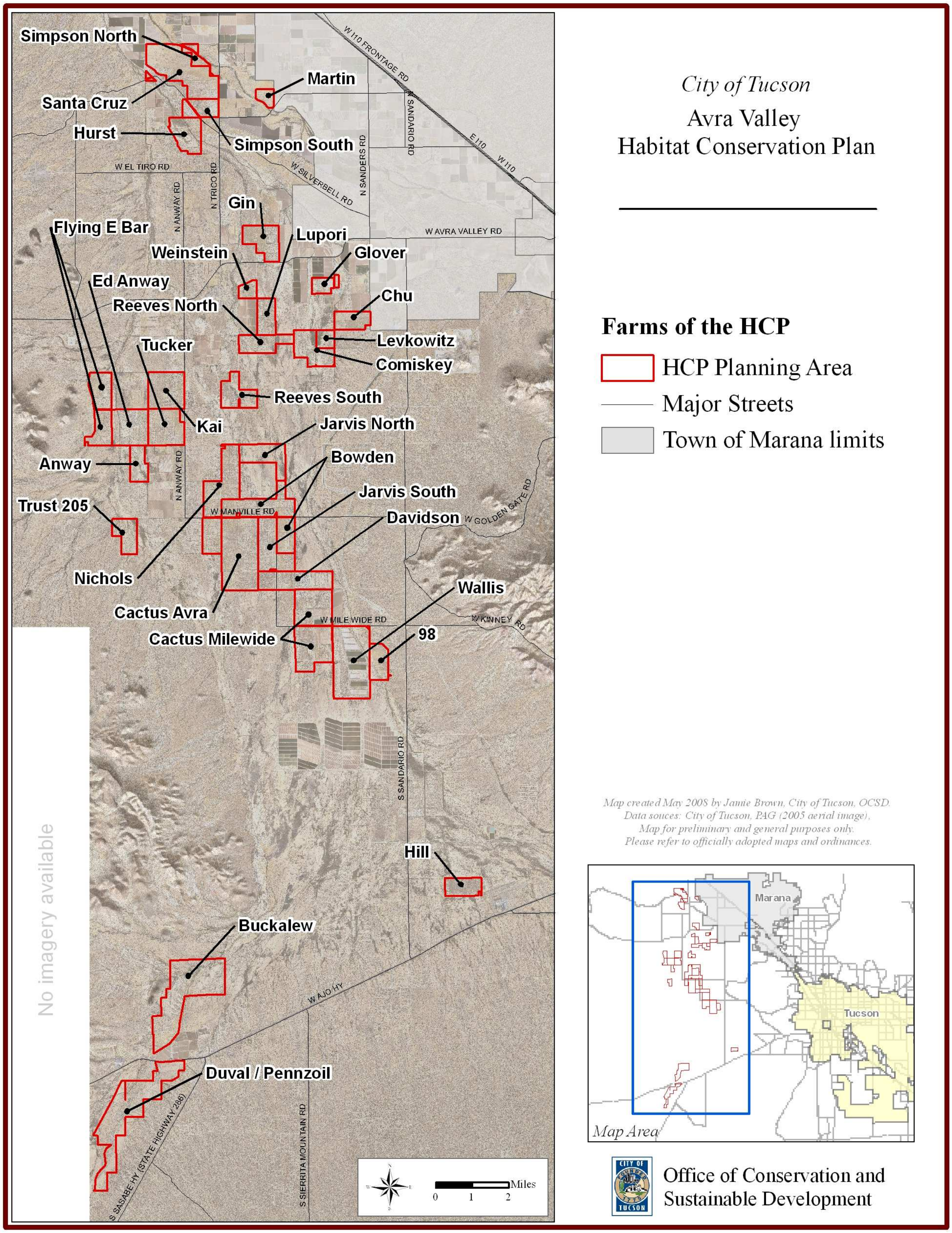

Figure 1.3-1. HCP Planning Area and farm names

1.5 Regulatory Framework

1.5.1 Federal Endangered Species Act

The ESA, and its implementing regulations, prohibit the take of any fish or wildlife species that are federally listed as threatened or endangered without prior approval pursuant to either Section 7 or Section 10(a)(1)(b) of the ESA. The ESA defines take as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Code of Federal Regulations (CFR) 50-17.3 further defines the term harm in the take definition to mean any act that actually kills or injures a federally listed species, including significant habitat modification or degradation.

Section 10(a) of the ESA establishes a process for obtaining a Permit, which authorizes nonfederal entities to incidentally take federally-listed wildlife or fish, subject to certain conditions. Incidental take is defined by ESA as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Preparation of an HCP is required for all Section 10(a) permit applications. The U.S. Fish and Wildlife Service (USFWS) and the National Oceanographic and Atmospheric Administration's Fisheries Service (NOAA Fisheries) have joint authority under the ESA for administering the incidental take program. NOAA Fisheries has jurisdiction over anadromous fish species, and USFWS has jurisdiction over all other fish and wildlife species.

Section 10(a) also was intended by the U.S. Congress (Congress) to authorize USFWS to approve HCPs for unlisted as well as listed species. Moreover, if an HCP treats an unlisted species as if it were already listed, additional mitigation will not be required within the area covered by the HCP upon the listing of that species. As stated by the Conference Committee when Section 10 was added to the ESA in 1982:

> *The committee intends that the Secretary [of the Interior] may utilize this provision to approve conservation plans which provide long-term commitments regarding the conservation of listed as well as unlisted species and long-term assurances to the proponent of the conservation plan that the terms of the plan will be adhered to and that further mitigation requirements will only be imposed in accordance with the terms of the plan. In the event that an unlisted species addressed in an approved conservation plan is subsequently listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act. (House of Representatives Conference Report No. 97-835, 97th Congress, 2d Session, p. 30)*

The "No Surprises" policy, adopted by the U.S. Department of the Interior, provides that landowners who have habitat for listed species on their property and agree to an HCP under the ESA will not be subject to later demands for more land, water, or financial commitment if the HCP is adhered to, even if the needs of the species changes over time (63 FR 8859).

Section 7 of the ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any species listed under the ESA, or to result in the destruction, or adverse modification, of its habitat. Technically, the issuance of a Permit is an authorization for take by a federal agency. Consequently, in conjunction with issuing a Permit, USFWS must conduct an internal Section 7 consultation on the proposed HCP. The internal consultation is conducted after an HCP is developed by a nonfederal entity and submitted for formal processing and review. Provisions of Sections 7 and 10 of the ESA are similar, but Section 7 requires consideration of several factors not explicitly required by Section 10. Specifically, Section 7 requires consideration of the indirect effects of a project, effects on federally listed plants, and effects on Critical Habitat. ESA requires that USFWS identify Critical Habitat to the maximum extent that it is prudent and determinable when a species is listed as threatened or endangered. The internal consultation results in a Biological Opinion prepared by USFWS regarding whether implementation of the HCP will result in jeopardy to any listed species or will adversely modify Critical Habitat.

1.5.2 The Section 10 Process – Habitat Conservation Plan Requirements and Guidelines

The Section 10 process for obtaining a Permit has three primary phases: 1) HCP development; 2) formal permit processing; and 3) post-issuance.

During the HCP development phase, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species. An HCP submitted in support of a Permit application must include the following information:

- Impacts likely to result from the proposed taking of the species for which permit coverage is requested;
- Measures that will be implemented to monitor, minimize, and mitigate impacts; funding that will be made available to undertake such measures; and procedures to deal with unforeseen circumstances;
- Alternative actions considered that would not result in take; and
- Additional measures USFWS may require as necessary or appropriate for purposes of the plan.

The HCP development phase concludes, and the permit-processing phase begins, when a complete application package is submitted to the appropriate permit-issuing office. A complete application package consists of 1) an HCP; 2) an Implementing Agreement; 3) a permit application; and 4) a $25 fee from the applicant. USFWS must also publish a Notice of Availability of the HCP package in the Federal Register to allow for public comment. USFWS also prepares an Intra-Service Section 7 Biological Opinion; and prepares a Set of Findings, which evaluates the Section 10(a)(1)(b) permit application in the context of permit issuance criteria (see below). An Environmental Assessment (EA) or Environmental Impact Statement (EIS) serves as USFWS's record of compliance with the National Environmental Policy Act (NEPA) after a 60- to 90-day public comment period on the document (see Section 1.5.3). No further NEPA review is required. An Implementing Agreement is required for HCPs, unless the HCP qualifies as a low-effect HCP. A Section 10 Permit is granted upon a determination by USFWS that all requirements for Permit issuance have been met. Statutory criteria for issuance of the Permit specify that:

- The taking will be incidental;
- The impacts of incidental take will be minimized and mitigated to the maximum extent practicable;
- Adequate funding for the HCP and procedures to handle unforeseen circumstances will be provided;
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild;
- The applicant will provide additional measures that USFWS requires as being necessary or appropriate; and
- USFWS has received assurances, as may be required, that the HCP will be implemented.

During the post-issuance phase, the Permittee and other responsible entities implement the HCP, and USFWS monitors the Permittee's compliance with the HCP as well as the long-term progress and success of the HCP. The public is notified of Permit issuance by means of the Federal Register.

1.5.3 National Environmental Policy Act

The issuance of a Permit by USFWS constitutes a federal action. The NEPA process requires that Federal agencies analyze the environmental impacts of their actions (in this instance, issuance of a Permit) and include public participation in the planning and implementation of their actions. The NEPA process helps Federal agencies make informed decisions with respect to the environmental consequences of their actions and ensures that measures to protect, restore, and enhance the environment are included, as necessary, as a component of their actions. NEPA compliance is obtained through one of three actions: 1) preparation of an EIS; 2) preparation of an EA; or 3) a categorical exclusion (allowed for low-effect HCPs). An EA is typically prepared for a moderate-effect HCP with an EIS required for high-effect HCPs. Low-effect HCPs, as defined in the HCP Handbook, are categorically excluded under NEPA. Preparation of an EIS is anticipated for the Avra Valley HCP.

Section 2

ACTIVITIES COVERED BY PERMIT

Activities to be covered by the City HCP Permit include any activities carried out by, or authorized by, the City on covered lands (i.e., the Permit Area identified in Section 1.3). These activities consist of Tucson Water development activities and associated capital improvement projects (CIPs) as described below.

2.1 Development Projections

A range of development activities is planned in the City Avra Valley planning area over the next 50 years. In the planning area, portions of 19,821 acres of City-owned lands will be used for future City water development projects. The regional context for the planning area is provided in Figure 1.1-2.

The spatial distribution of these planned land uses is tied to current resource conditions. The resource conditions vary greatly within the City Avra Valley HCP planning area, including lands that are largely disturbed former agricultural lands, ephemeral washes with associated xeroriparian habitat, and some undeveloped land with native vegetation.

2.2 Capital Improvement Projects

2.2.1 Public Water Infrastructure Installation

The development of additional public water infrastructure on City-owned lands in Avra Valley may occur over the next 50 years. The Avra Valley planning area includes lands acquired by Tucson Water for water rights. Many of these lands are former agricultural lands and have been highly degraded. The Avra Valley holdings may also be the primary location for future water resources development projects by Tucson Water. Tucson Water recently completed an update of its 50-year water resources plan, *Water Plan* 2000-2050 (City of Tucson Water Department 2004). Many of the future activities in Avra Valley are dependent on decisions still to be made by the community and the City's Mayor and Council regarding enhanced treatment for mineral content (salinity control) and the utilization of effluent. While the individual projects that will be required to implement these future decisions are not specifically known, the listed activities below encompass the range of potential projects that may be required to meet the future water needs of Tucson Water's service area.

The following list of activities is intended to be as inclusive as possible to accommodate future water resources development projects that may be required to meet water demand associated with future urban growth. The list includes construction and maintenance of typical water facilities including:

- Wells
- Treatment Plants
- Reservoirs
- Boosters
- Transmission mains
- Pipelines

- Recharge Basins
- Evaporation Ponds
- Wetlands
- Flood-control projects such as berms and basins
- Administrative buildings and facilities
- Maintenance yards
- Access roads to all facilities
- Solar energy facilities

The Plan would allow for the possibility of brine disposal and related landfill activities encompassing up to 5,600 acres in addition to the necessary pipelines to transport brine. The Plan would also allow for the possibility of expansion of existing and planned recharge facilities encompassing up to 1,000 acres. In addition, the Plan would allow for the possibility of a 100-acre Treatment Plant and a well-field encompassing up to 600 acres. Additional recovery wells associated with recharge facilities may be required and would be anticipated to encompass up to 100 by 100 feet (30.5 by 30.5 meter) sites. Pipelines conveying recovered, treated or brine water may be required, with determination of location and length dependent on future decisions of the community and Mayor and Council.

All construction projects are subject to Tucson Water's Design Standards and Tucson Water's Standard Specifications and Details (Construction Standards) as supplemented by the County (County-City) Public Improvements Standard Specifications. Surface restoration is required on all construction projects, including revegetation or mitigation of plants protected under the County Native Plant Protection Ordinance (NPPO).

2.2.2 Maintenance Activities

WATER INFRASTRUCTURE MAINTENANCE

Pipeline and Valve Maintenance

Maintenance activities associated with pipelines and valves include valve exercising, marking blue-stakes for main locations, routine hydrant and main flushing, chlorine residual and bacteriological testing, and routine inspections to ensure that the existing facilities are in good repair and in working condition. One or two person crews with light trucks, 1 ton or less, generally perform these activities quarterly.

Pipeline and Valve Repairs

Pipeline and valve repairs include repairing mainline breaks and the replacement of leaking and/or failing valves. The ground disturbance associated with these activities generally is limited by easement width or within public ROWs. These activities are not regularly scheduled and typically are performed on an emergency basis. Construction crews usually consist of two to ten people. Project duration typically is less than one week but can be much longer in extreme cases. Repair or replacement can include aboveground installation of temporary pipelines to maintain service.

2.3 Activities Not Covered by the Permit

Activities carried out or authorized by public or private parties other than the City are not covered by this HCP and resulting Permit unless explicitly identified above. With respect to waters downstream and land outside of the City, covered activities will be specifically restricted to those impacts resulting from City operations and facilities on species using the areas and covered in this HCP.

Activities within the Permit Area that are not covered by this HCP include those occurring on: 1) any properties that have received development permits in the form of an approved preliminary plat at the time the Permit is issued; and 2) properties that have completed or are in the process of completing a Section 7 or Section 10 consultation with USFWS at the time the Permit is issued.

Construction and maintenance of grade control structures and bank protection maintenance is performed by the PCRFCD and therefore is not covered. Covered activities also do not include the operation and maintenance of facilities used to collect, treat, or release water or treated effluent; and the impacts of increased, decreased, or otherwise altered water quality or availability, except for those impacts directly resulting from activities carried out, or authorized, by the City and having all required federal permits.

2.4 Implementation of the HCP

Any incidental take of covered species that results from activities associated with the implementation of the mitigation measures and monitoring program associated with the HCP is covered under this HCP. These covered activities include management of habitat that is acquired, created, or restored in implementing the HCP as well as required surveys and monitoring activities. Mitigation, management and monitoring activities implemented by qualified third parties on behalf of the City for these purposes also are covered.

Section 3

ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES

This section provides an overview of the environmental setting and biological resources in Tucson and the adjacent lands that are relevant to this HCP. Existing habitat conditions and population status for covered species are contained in Section 4, Covered Species.

The Avra Valley planning area includes approximately 19,821 acres of City-owned land located in unincorporated Pima County, between the Tucson Mountains to the east and the Waterman and Roskruge Mountains on the west. This planning area consists largely of noncontiguous formal agricultural properties, which the City purchased during the 1970s and 1980s for the purpose of acquiring those water rights tied to the lands.

3.1 Physical Setting

Tucson is situated within the Basin and Range Physiographic province. Broad, alluvial basins lying between relatively isolated mountain ranges and dissected uplands typify this province. Within this province, sediments from the mountain ranges are slowing filling the intervening basins (Bates and Jackson 1997). The Tucson Basin forms a portion of the upper Santa Cruz River Basin, which encompasses approximately 750 square miles (1,943 square kilometers). The ephemeral Santa Cruz River parallels the mountain fronts and drains towards the northwest to its confluence with the Gila River. Mountains bordering the Tucson Basin include the Santa Catalina and Rincon Mountains to the northeast and the Tucson Mountains on the west. The Santa Catalina and Rincon Mountains reach a maximum elevation of approximately 9,100 feet (2,776 meters), while the Tucson Mountains reach approximately 4,700 feet (1,434 meters). The Rincon Mountains are comprised of folded and foliated banded gneiss, schist, and granite of Precambrian age, overlaid by Tertiary and younger alluvial and colluvial deposits. Often the colluvium forms a thin cover over pediment surfaces. In the Tucson Mountains, the dominant geologic formations include Permian and Cretaceous limestone, arkose, red beds, and Tertiary intrusives and volcanics. Quaternary gravels are also present and cover most of the pediments (Streitz 1962). The lower flanks of the Tucson and Rincon Mountains are covered by terrace deposits or other alluvium ranging from 100 feet (30 meters) thick near the Rincon Mountains, to approximately 400 feet (122 meters) thick near the Tucson Mountains (National Park Service [NPS] 1995). The geologic pattern of the Santa Rita Mountains, with Mount Wrightson (9,453 feet [2,883 meters]) as the highest point, includes thrust faults with slices of Paleaozoic sedimentary rocks sitting astride or leaning up against a Precambrian core (Chronic 1983). An especially large alluvial fan, with numerous stream-cut channels, spreads out below the Santa Rita Mountains.

The Tucson Basin is filled with fluvial, lacustrine, and debris flow deposits derived from the erosion of the surrounding mountains farther up the drainage. At the center of the basin is a dissected graben structure where large accumulations of fine-grained sediments and evaporites are present (Leake and Hanson 1987). Alluvial fan deposits occur along the perimeter of the basin, while river channel and floodplain deposits are common on the basin floor and make up the larger proportion of the fill. Basin deposits are typically Tertiary and Quaternary in age, and may be as much as 8,000 feet (244 meters) thick (Streitz 1962). Geologic factors controlled the formation of the valley fill and determined the textural and structural relationships of the basin sediments. The characteristics of the sediments in turn control the occurrence and movement of surface water and groundwater in the basin (Kidwai 1957).

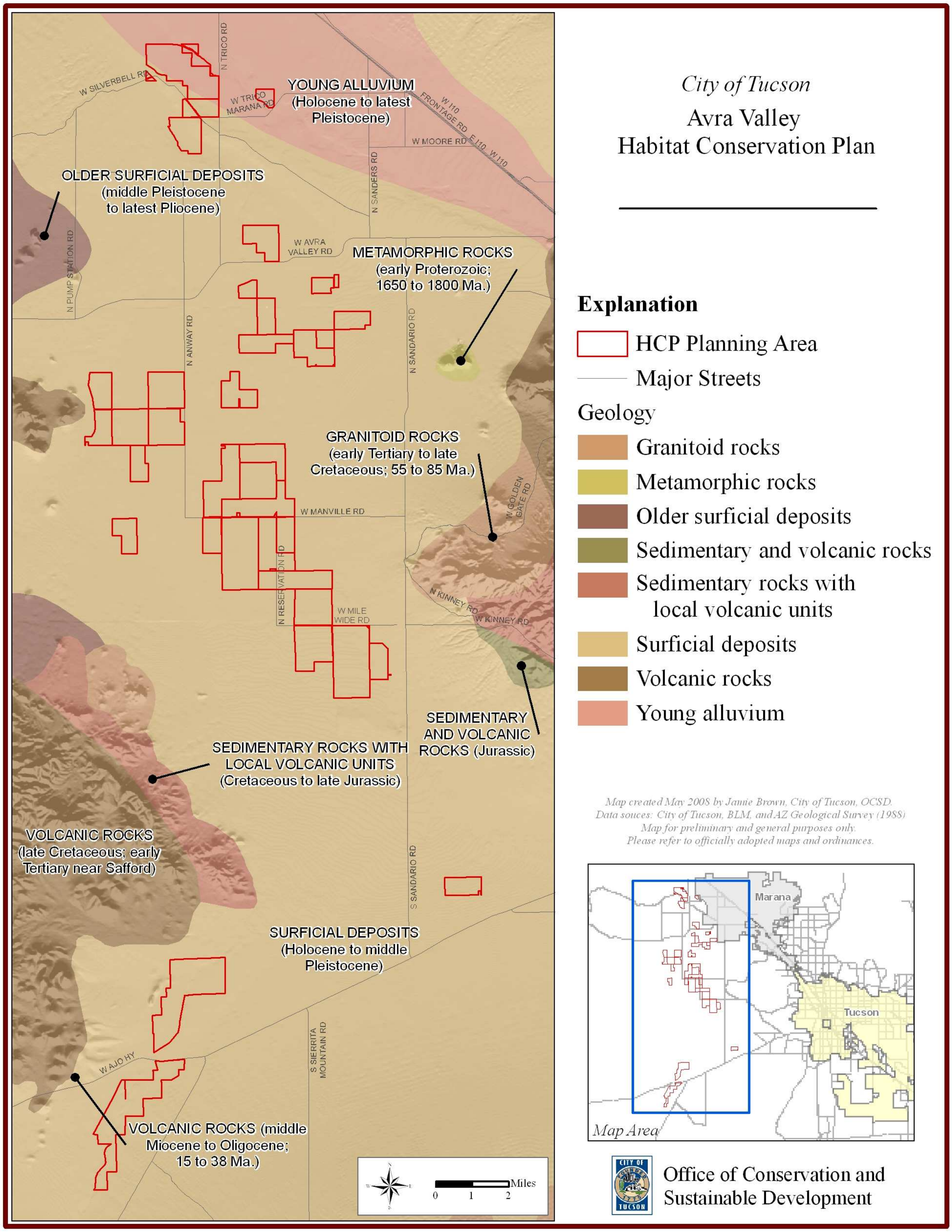

Figure 3.1-1. Geology within and around the planning area.

Figure 3.1-1 shows the geology of the planning area and surroundings as mapped by the Arizona Geological Survey in 1988 and later digitized by the Bureau of Land Management.

Soils in the Tucson Basin, which were formed by erosion of surrounding mountain ranges, are typically shallow, coarsely textured, and well-drained on the mountain slopes. Soils on the bajada are alluvial and contain sandy or rocky areas with distinct plant associations (NPS 1995). These soils lend themselves to rapid recharge, although recharge normally does not occur outside stream channels because antecedent soil moisture is usually very low, evaporation is very high, and rainfall amounts are insufficient to push the wetted front to ground water depths. An impermeable layer of caliche frequently forms at this depth, which can limit plant establishment and growth. Because alluvium within stream channels, fans, and bajadas is very permeable, streams spread out and rapidly lose flow as they leave the steep mountain gradients and enter the alluvial flats (Osterkamp 1973a).

The HCP planning area is located within the Tucson Active Management Area (Tucson AMA) (figure 3.1-2), which includes the Avra Valley Sub-basin and the Upper Santa Cruz Sub-basin north of the Pima County–Santa Cruz County line. The Tucson AMA is one of five AMAs in the state established pursuant to the 1980 Groundwater Management Act (GMA). The Tucson AMA has a statutory goal of achieving safe-yield by 2025 and maintaining it thereafter. Safe-yield means that the amount of groundwater pumped from the AMA on an average annual basis does not exceed the amount that is naturally or artificially recharged. Ground water in the Tucson Basin occurs under confined or water table conditions. Permeability is greatest in the streambed of the Santa Cruz River; a perched sand and gravel aquifer is isolated from the underlying regional aquifer by a thick clay lens. Groundwater depth in the planning area ranges from 70 to more than 200 feet (21 to 61 meters) below ground surface.

Elevations within the Avra Valley planning area range from approximately 1,884 feet (574 meters) at the northernmost parcel to 2,655 feet (809 meters) at the southernmost parcel (Figure 3.1-3). There are few bedrock outcrops in Avra Valley; however, none are located within the Avra Valley planning area. The landform characteristic of the Avra Valley planning area is deep valley fill, with materials derived from the Tucson Mountains to the east and the Waterman and Roskruge Mountains to the west. Soils are deep alluvial and consist of varying proportions of sand, loam, and gravel.

The major drainage through Avra Valley is Brawley Wash, which is a complexly braided system with many small tributaries. Brawley Wash is the downstream continuation of Altar Wash, and is a major tributary of the Santa Cruz River. The Brawley Wash system is joined by two major washes: Black Wash from the Snyder Hill-Javier region and Blanco Wash from the Roskruge-Waterman mountains region. According to Rosen (2005), who conducted an ecological reconnaissance of Avra Valley, large portions of Brawley Wash are highly degraded barrens with adobe soils and low perennial plant diversity. Rosen suggests that Blanco Wash contains a higher proportion of relatively intact natural environments than Brawley Wash.

Because Avra Valley is generally flat, floodwater drainage throughout most of Avra Valley is by sheet flow, which collects in a few tributaries of Brawley Wash, or impounds behind human-made structures, such as roads and berms. Much of the Avra Valley planning area is within the Federal Emergency Management Agency (FEMA) Designated 100-year floodplain. Major flood events occurred in this area in 1983 and 1993, with water remaining for several months on some of the Avra Valley planning area parcels. Evidence of flooding in Avra Valley includes dead trees, bare ground, and deep silt deposits. Following the 1993 floods, some impediments to surface flow (i.e. berms) were removed and some drainage ditches were dug. These actions may reduce future flood impacts to the Avra Valley planning area.

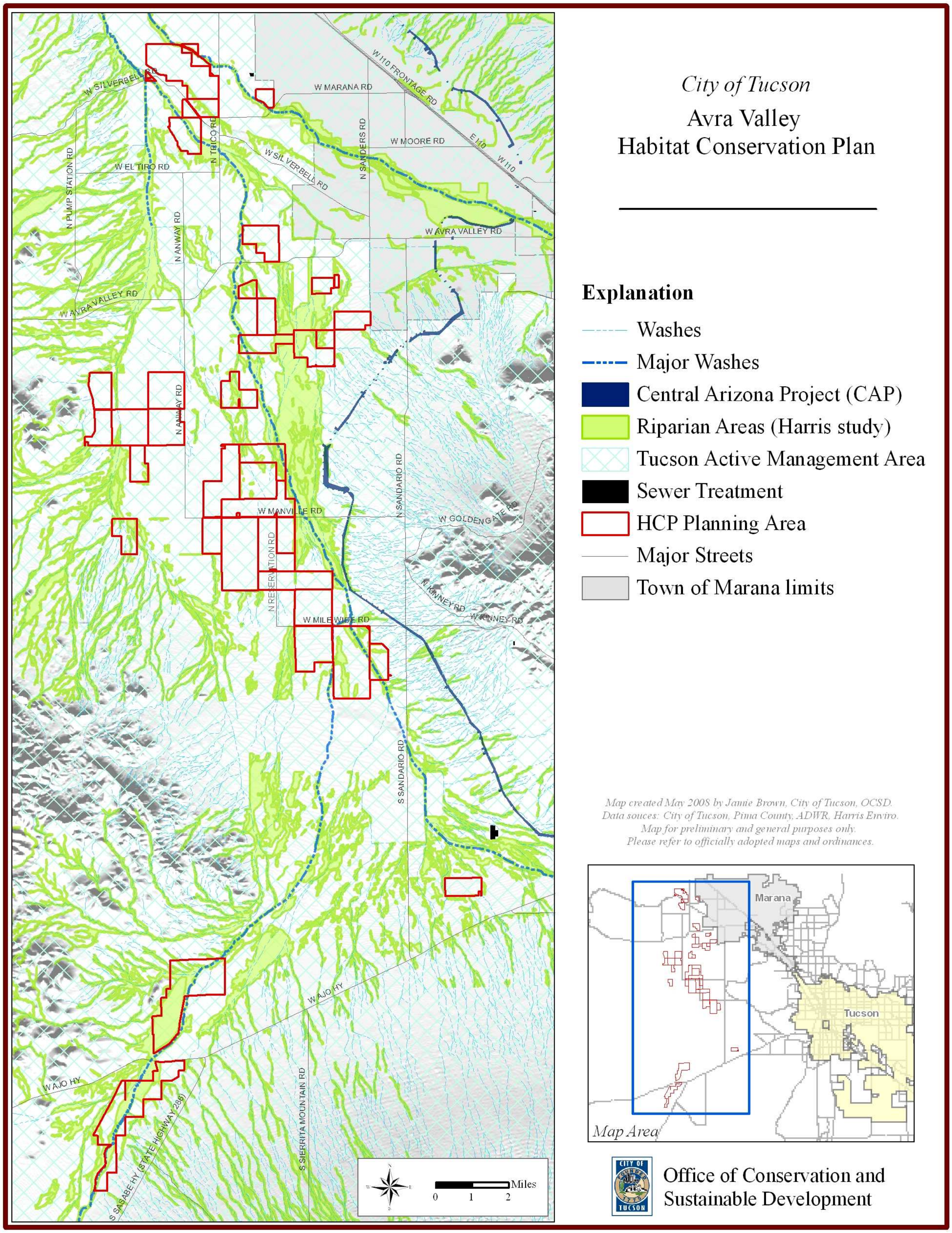

Figure 3.1-2. Surface water (ephemeral, except for effluent-dominated Santa Cruz River), riparian ecosystems, and water management.

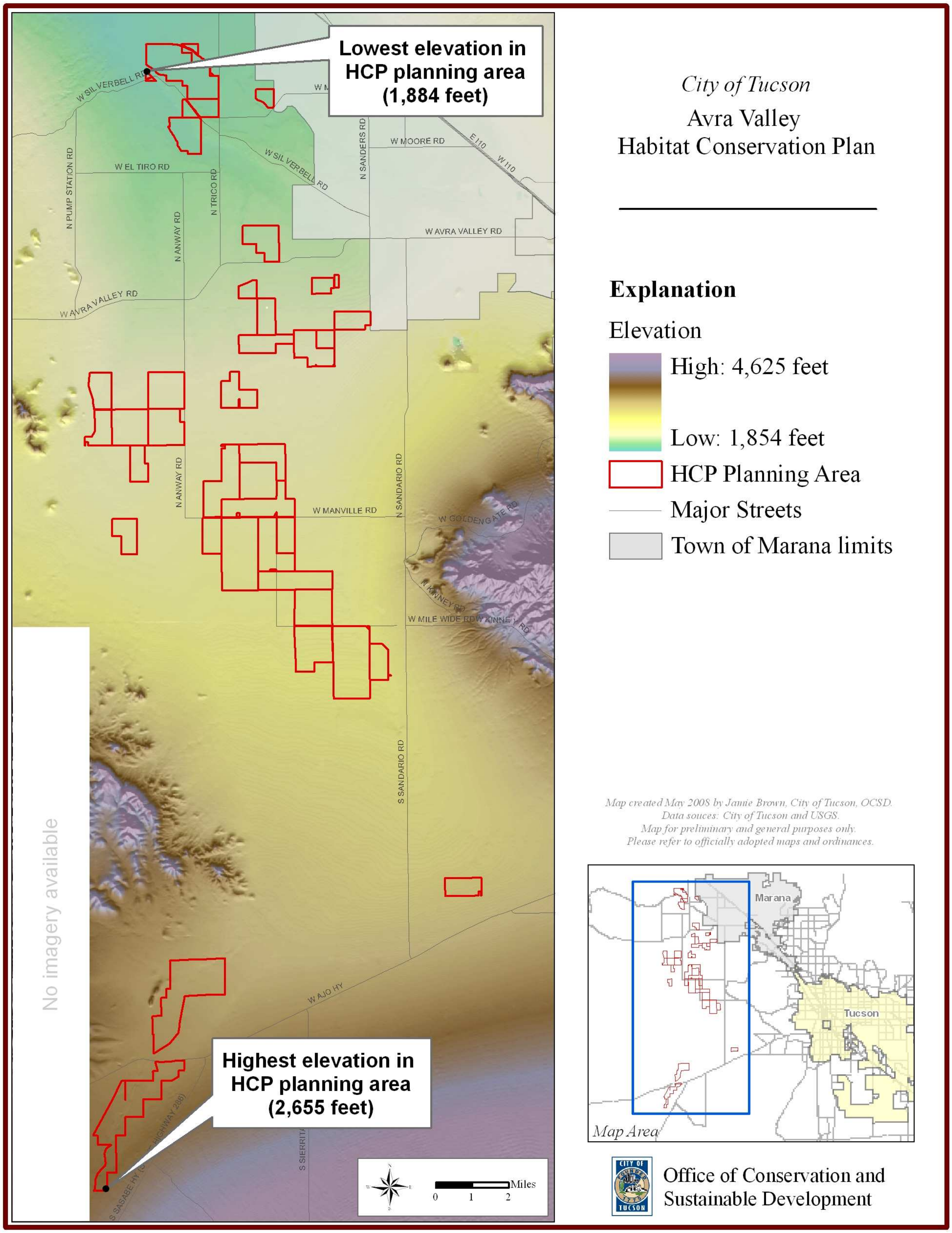

Figure 3.1-3. Elevation within the HCP planning area.

There is no naturally occurring perennial surface water within the Avra Valley planning area, or elsewhere within Avra Valley. However, the Central Arizona Project (CAP) canal conveys Colorado River water north-to-south through Avra Valley and several CAP water recharge basins have been constructed on City land in Sections 5 and 8, Township 14 South, Range 11 East. The Santa Cruz River is an effluent-dominated stream. Approximately 70,000 acre-feet per year (af/yr) of wastewater is currently treated to the appropriate Surface Water Quality Standards by the two metropolitan treatment plants owned and operated by Pima County: Roger Road Wastewater Treatment Facility and Ina Road Water Pollution Control Facility. The majority of this water is discharged into the Santa Cruz River as effluent. The Santa Cruz River crosses the northern boundary of Avra Valley, intersecting three parcels within the Avra Valley planning area discussed in this report (Simpson Farm North, Santa Cruz Farm, and Martin Farm). These parcels, and the other City-owned properties in Avra Valley, are described in detail in SWCA (2003a).

3.2 Climate

The average precipitation at the Tucson International Airport is between 11 and 12 inches (28 to 31 centimeters) per year. However, actual precipitation within the three HCP planning areas varies as a result of elevation differences. Tucson International Airport is located at an elevation of 2,643 feet (806 meters) above mean sea level. Lowe (1964) estimated that an increase in elevation of 1,000 feet (305 meters) results in an increase in annual precipitation of 4 to 5 inches (10 to 12 centimeters). Precipitation occurs in a bi-seasonal pattern during summer monsoons and winter storms. Winter temperatures in the Tucson Basin range from an average low of 38 degrees Fahrenheit (°F) (3 degrees Celsius [°C]) to an average high of 67°F (19°C). In the summer, the average low is 71°F (22°C), and the average high is 101°F (38°C) (NOAA 1997).

Southern Arizona has been experiencing drought conditions since 1996 (Jeff Phillips, USGS water resources specialist, unpublished information). For the Tucson area, the period between September 2005 and January 2006 was the driest ever, with just 0.01 inch (0.025 centimeter) of precipitation (*Arizona Daily Star* 2006). In the planning area, the absence of rainfall stresses vegetation and wildlife populations and increases the threat of wildfire; the presence of buffelgrass, a drought-tolerant forage grass, further exacerbates the threat of wildfire.

3.3 Vegetation

Vegetation communities within the Avra Valley planning area include upland and riparian (Figure 3.3-1, Table 3.3-1), both of which have been extensively modified by human activities. Upland vegetation communities include semidesert grassland, Sonoran desertscrub, and Sonoran vacant or fallow land. Riparian vegetation communities include Sonoran desertscrub xeroriparian and Sonoran riparian deciduous woodland.

Semidesert Grassland is present at the south end of the Avra Valley planning area (Buckelew Farm and Duval/ Pennzoil Farm parcels) at an elevation range of approximately 2,300 to 2,655 feet (701 to 809 meters). The dominant tree in this community is the velvet mesquite (*Prosopis velutina*), and the dominant shrub is creosote bush. Additional shrub species include burroweed (*Isocoma tenuisecta*) and snakeweed (*Gutierrezia sarothrae*). Grass species include poverty threeawn (*Aristida ternipes*), purple threeawn (*A. purpurea*), needle grama (*Bouteloua aristidoides*), feather fingergrass (*Chloris crinita*), and Lehmann lovegrass (*Eragrostis lehmanniana*), which may be the most abundant grass species in the Avra Valley planning area. Another exotic grass, buffelgrass, is a major problem in the Avra Valley planning area.

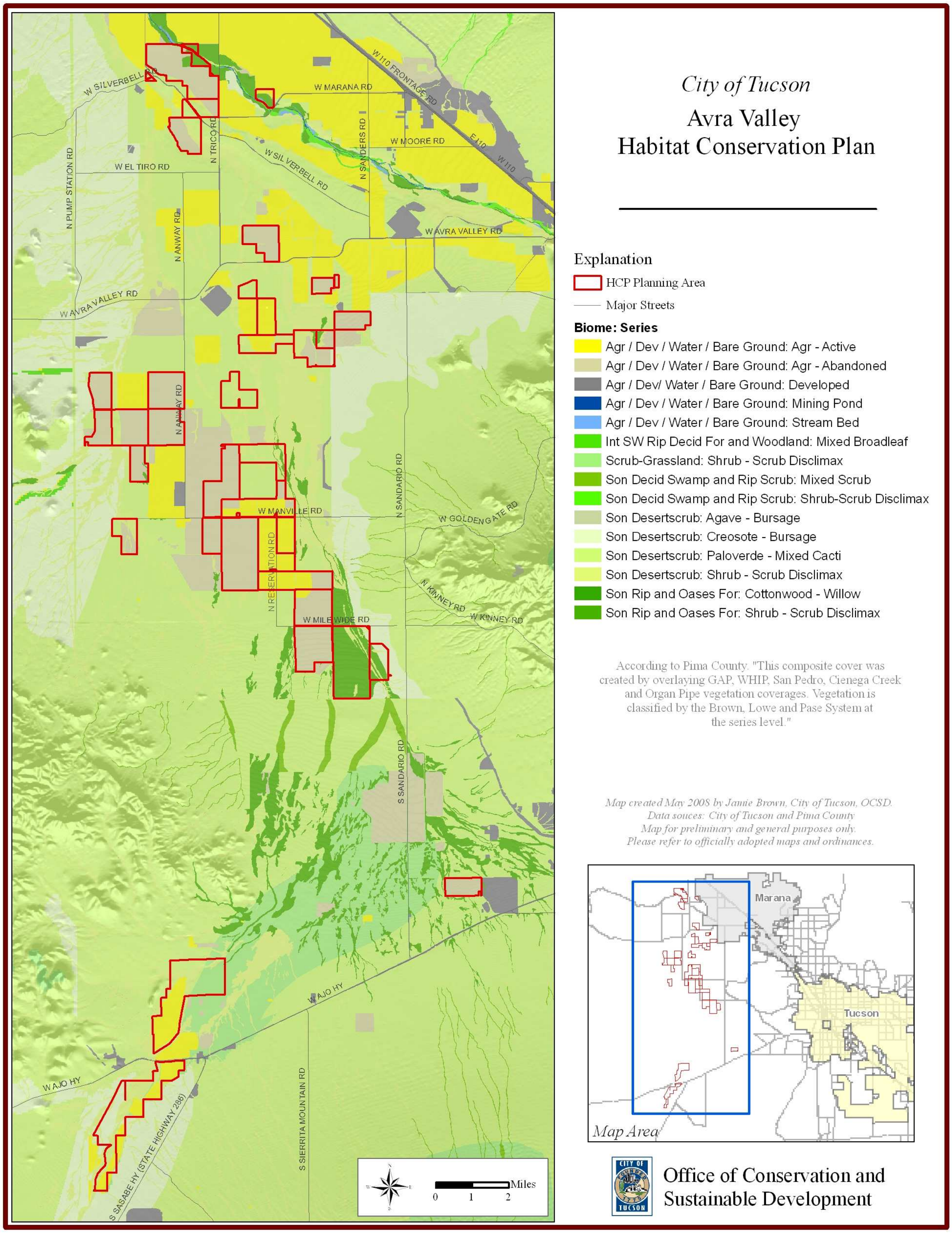

Figure 3.3-1. Vegetation and land cover in the Avra Valley Planning Area.

Table 3.3-1. Vegetation / Land Cover Type in Avra Valley Planning Area

Biome and Series / Land Cover Type	Acres	Percent
Agriculture / Developed / Water / Bare Ground: Agriculture - Active	3,663	18.48
Agriculture / Developed / Water / Bare Ground: Abandoned	9,764	49.26
Agriculture / Developed / Water / Bare Ground: Developed	54	.27
Agriculture / Developed / Water / Bare Ground: Stream Bed	7	.04
Scrub-Grassland (Semidesert Grassland): Shrub –Scrub Disclimax	448	2.26
Sonoran Deciduous Swamp and Riparian Scrub: Shrub –Scrub Disclimax	8	.04
Sonoran Desertscrub: Creosote – Bursage	548	2.76
Sonoran Desertscrub: Paloverde – Mixed Cacti	1,642	8.29
Sonoran Desertscrub: Shrub – Scrub Disclimax	2,008	10.13
Sonoran Riparian and Oases Forests: Cottonwood - Willow	9	.05
Sonoran Riparian and Oases Forests: Shrub – Scrub Disclimax	1,670	8.42
Total	**19,821**	**100.00**

Sonoran Desertscrub is the most prevalent, natural vegetation community within the Avra Valley planning area. It occurs on portions of the Avra Valley planning area that have not been used previously for agricultural production. The dominant vegetation in this community is dependent to a large degree on slope, soils, and exposure. Creosote bush and triangle-leaf bursage (*Ambrosia deltoidea*) are dominant on lower elevation lands that are flat and generally have very deep, fine alluvial soil. The vast majority of the undisturbed upland vegetation within the Avra Valley planning area is dominated by these two species. Foothills palo verde (*Cercidium microphyllum*), triangle-leaf bursage, and cacti dominate the higher elevation rocky slopes located at the edges of Avra Valley. Saguaros (*Carnegiea gigantea)* may be present, although there are few within the Avra Valley planning area.

Agricultural lands are the most numerous within the Avra Valley planning area. These communities consist primarily of fallow and vacant lots within the urban setting. Rosen (2005) concluded that many or most former agricultural lands owned by the City are succeeding toward viable natural habitat conditions supporting diverse plant communities. Plants commonly established here include velvet mesquite, burroweed, desert broom, desert globe mallow (*Sphaeralcea ambigua*), prickly Russian thistle (*Salsola tragus*), silverleaf nightshade (*Solanum elaeagnifolium*), western tansymustard (*Descurainia pinnata*), shaggyfruit pepperweed (*Lepidium lasiocarpum*), and several species of grasses, mostly non-native. On some of the City-owned lands, non-native grasses were planted in the 1980s. Mowing of vegetation occurs periodically on many parcels within the Avra Valley planning area. The goal of this management technique is to prevent weed growth, but it also has the consequence of preventing succession to a shrub or tree-dominated plant community. Sonoran riparian and oases forest is a riparian community dominated by velvet mesquite (as trees) or Fremont cottonwood (*Populus fremontii*) and/or Goodding willow (*Salix gooddingii*).

This vegetation type is typically dominated by structurally diverse stands of velvet mesquite that range from open to dense. Mesquites sometimes have a large amount of mistletoe (*Phoradendron californicum*), a native parasite that may indicate stress to the trees. Other species commonly present in this vegetation type are catclaw acacia and blue palo verde. Midstory species include pitseed goosefoot (*Chenopodium berlanderi*), lotebush (*Zizyphus obtusifolia*), burrobrush, desert broom, and four-wing saltbush. Prickly Russian thistle, camphorweed (*Heterotheca subaxillaris*), and several species of grasses, vines and forbs are present in the understory. Trees may be more than 50 feet (15 meters) tall and very dense. Other species commonly found in this community include velvet ash (*Fraxinus pennsylvannica* var. *velutina*), netleaf hackberry (*Celtis reticulata*), velvet mesquite, and saltcedar (*Tamarisk ramosissima*).

3.4 Wildlife

Wildlife habitat for any given species can be best described as a combination of vegetation and landform. Landform, in turn, reflects topography, soil, and other habitat features. The Avra Valley planning area contains areas that have been extensively modified by ranching, agriculture, floodplain modifications, Off Road Vehicles (ORVs), wildcat dumping, and other human activities. Human activity in some cases extends back more than 12,000 years. The wildlife communities present reflect these differences in the level of human activity.

Areas of valley bottom with intact native vegetation support wildlife characteristic of the Lower Colorado River Valley Subdivision of the Sonoran Desertscrub biome. These areas are important to some species of wildlife, notably western burrowing owl (*Athene cunicularia*), ground snake (*Sonora semiannulata*), and the Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*). Soil conditions, rather than vegetation, are a key habitat feature for many fossorial species in the uplands of Avra Valley. Rosen (2005) found that mammal burrows were abundant and diverse in size at several of the former agricultural fields within the Avra Valley planning area.

Xeroriparian vegetation, associated with Brawley Wash and Black Wash, is present on several parcels within the Avra Valley planning area. These wash corridors support a higher density and diversity of birds and mammals than do adjacent uplands. They also provide important habitat linkages for a variety of species, including cactus ferruginous pygmy-owl, that move between habitat patches.

The Avra Valley planning area supports a wide variety of reptiles, including sidewinder (*Crotalus cerastes*), western diamondback rattlesnake (*Crotalus atrox*), common gopher snake (*Pituophus melanoleucus*), western whiptail (*Cnemidophorus tigris*), desert iguana (*Dipsosaurus dorsalis*), zebra-tailed lizard (*Callisaurus draconoides*), and tree lizard (*Urosaurus ornatus*). Notable and common breeding bird species include rufous-winged sparrow (*Aimophila carpalis*), Swainson’s hawk (*Buteo swainsonii*), Western kingbird (*Tyrannus verticalis*), curve-billed thrasher (*Toxostoma curvirostre*), verdin (*Auriparus flaviceps*), ash-throated flycatcher (*Myiarchus cinerascens*), cactus wren (*Campylorhynchus brunnei-capillus*), Northern mockingbird (*Mimus polyglottos*), greater roadrunner (*Geococcyx californianus*), white-winged dove (*Zenaida asiatica*), and mourning dove (*Zenaida macroura*). Mammals common to the area include the round-tailed ground squirrel (*Spermophilus tereticaudus*), white-throated woodrat (*Neotoma albigula*), kangaroo rat (*Dipodomys* spp.), pocket mouse (*Perognathus* spp.), desert cottontail rabbit, black-tailed jackrabbit, and coyote. Rosen (2005) found antelope jackrabbit (*Lepus alleni*), a southwestern endemic species, to be abundant on City-owned properties south of Ajo Way at Three Points.

Section 4

COVERED SPECIES

4.1 Introduction

The City of Tucson is covering seven species as part of the Avra Valley Habitat Conservation Plan (HCP):

- Lesser long-nosed bat;
- Cactus ferruginous pygmy-owl;
- Western burrowing owl;
- Tucson shovel-nosed snake;
- Ground snake (valley form);
- Pale Townsend’s big-eared bat; and
- Western yellow-billed cuckoo.

The purpose of the habitat conservation planning process and subsequent issuance of an Incidental Take Permit (Permit) is to authorize the incidental take of threatened or endangered species. Generally, Permit applicants include all federally listed wildlife species likely to be incidentally taken during the life of the Permit. It is also advised to address unlisted species in the HCP permit area that are likely to be listed within the foreseeable future or within the life of the Permit. The Permit applicant usually wants to consider including Federally listed plants in the HCP to avoid jeopardizing these species, as prohibited in section 7(a)(2). This section presents the species-specific baseline conditions in the City HCP planning area. Each species is individually addressed. For each species, baseline information is presented on the species’ status and distribution, life history and habitat requirements, existing population status and habitat conditions in the HCP planning area, and potential impacts to the species from the proposed covered activities. In consideration of this information, Section 5 will list biological goals and objectives for each species and describe the conservation program intended to minimize and mitigate impacts of covered activities pursuant to those goals and objectives. Section 6 provides an evaluation of the effects on each species of implementing the HCP.

To facilitate the development of a conservation program for the City HCP, the existing habitat models for all target species were evaluated with respect to perceived accuracy of extent and distribution within the City’s HCP planning area. For all seven of the covered species, the City’s Technical Advisory Committee recommended that the County’s SDCP habitat models not be used for the Avra Valley HCP as they did not provide a sufficient level of detail. The City’s habitat models were developed based on input from the Technical Advisory Committee (TAC), USFWS staff, local species experts, or the Town of Marana’s HCP species habitat models.

4.2 Lesser long-nosed Bat (*Leptonycteris curasoae yerbabuenae*)

4.2.1 Population Status and Ecology

RANGE AND DISTRIBUTION

The range of lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) extends from El Salvador, in Central America, northward through much of southern, western, and northwestern Mexico, including Baja California, to south-central and southeast Arizona and southwest New Mexico. In Arizona, lesser long-nosed bat is found from the Picacho Mountains to the Agua Dulce Mountains in the southwest and the Galiuro and Chiricahua mountains in the southeast (Figure 4.2-1). There are also two late-summer records of immature individuals from the Phoenix area and one from the Piñaleno Mountains.

TAXONOMIC UNIQUENESS

The lesser long-nosed bat was formerly known as Sanborn's long-nosed bat (*L. sanborni*). The Sanborn's big-eared bat and the greater (= Mexican) long-nosed bat (*L. nivalis*), prior to 1957, were considered to be the same species. The greater long-nosed bat was listed as endangered at the same time as the Sanborn's big-eared bat. Taxonomic work completed after the species was listed (Cockrum and Petryszyn 1991) concluded that *L. sanborni* is conspecific with *L. curasoae* and recognized two subspecies, a northern subspecies (*L. c. yerbabuenae* = *L. sanborni*) and a southern subspecies (*L. c. curasoae*). Wilkinson and Fleming in 1995 (USFWS 1995) confirmed the genetic distinctness of the two L. curasoae subspecies, along with the L. curasaoe and L. nivalis species.

POPULATION STATUS AND THREATS

Range-wide Population Status and Threats. The lesser long-nosed bat is currently federally listed as endangered. Populations are believed to have declined significantly, and federal listing was based on the reduction of the number of maternity colonies and declines in the size of remaining maternity colonies in Arizona and Sonora as a result of exclusion and disturbance. Additionally, it was believed that the lesser long-nosed bat might have been negatively affected over large areas of northern Mexico by reductions in the availability of native agaves from harvesting for local manufacture of mescal and tequila. Heavy browsing on newly emergent flower stalks of agaves by both cattle and deer also has been suggested as possibly decreasing foraging opportunities and thus contributing to declines in these bats. However, Cockrum and Petryszyn (1991) found little evidence to document a long-term decline in *Leptonycteris* populations in Arizona, New Mexico and Sonora, and recent surveys have indicated that population sizes are much larger than those reported in the 1980s (Hinman and Snow 2003).

As of 1994, major roosts (maternity and non-maternity) were documented at 20 general locations in Arizona and Mexico (Table 4.2-1). Population estimates are from 1992–1993, except where otherwise noted (USFWS 1995).

Arizona Populations Status and Threats. Arizona is at the extreme northern edge of the lesser long-nosed bat's distribution. In addition to its federal status, the bat is a state endangered species. Lesser long-nosed bats are known to occur in Arizona from the international border north to the Picacho Mountains, and from the Chiricahua Mountains west to the Agua Dulce Mountains (AGFD 2003a).

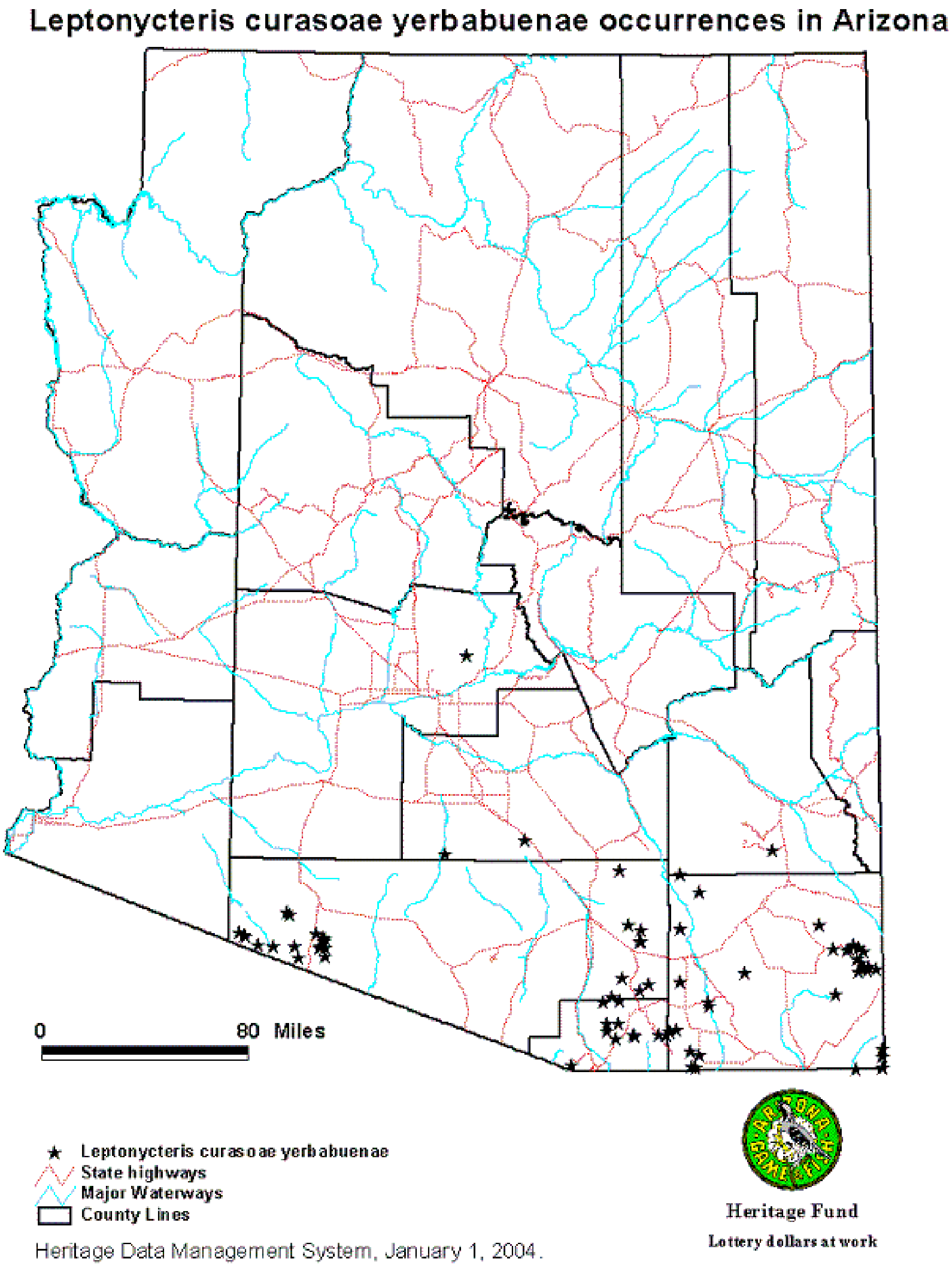

Figure 4.2-1. Habitat range and occurrence of the lesser long-nosed bat in Arizona. Points represent all occurrences of one or more individuals, including netting records based on locations reported in the HDMS. Source: AGFD

Table 4.2-1. Known Bat Locations and Population Estimates from Arizona and Mexico

Site	Location	Roost Type	Population estimates
Bluebird Mine	Cabeza Prieta National Wildlife Refuge, Pima County	maternity	ca. 3000
Copper Mountain Mine	OPCNM, Pima County	maternity	10,400 adults (early May) 20,000 adults (mid-May) 17,909 (July) 15,166 (August)
Old Mammon Mine	near Casa Grande, Pinal County	maternity	ca. 3600 adults/young
Patagonia Bat Cave	CNF, Santa Cruz County	transitory roost	19,800 adults/young 55,000–58,000 (Aug. 13, 1994) 38,000 (Aug. 25, 1994) 19,800 (Aug. 29, 1994) 3,400 (September 1994)
Hilltop Mines	Chiricahua Mountains, Cochise County	transitory roost	200–400
Box Canyon Crevice	Saguaro National Monument, Pima County	transitory roost (possible maternity)	211 (1967) 1–2 (1991)
Manila Mine	Fort Huachuca, Cochise County	transitory roost	20–45 (1991) 1,400
State of Texas Mine	Cochise County	non-maternity	ca. 20,000 12,550 (mid-Aug. 1994) 14,000 (late Aug. 1994)
Cave of the Bells	Pima County	non-maternity	1,500–2,000 (1987) no bats documented since 1989
Pinacate Cave	Sonora, Mexico	maternity	more than 80,000 adults (1992) ca. 130,000 adults (1993)
Tajitos Mine	Sonora, Mexico	maternity	
Cueva del Tigre	Sonora, Mexico	maternity	ca. 1,000 adults
Sierra Kino-Isla Tiburron Caves	Sonora, Mexico	maternity	up to 2,600 adults (1989-1995)
Santo Domingo Mine	Sonora, Mexico	maternity	ca. 1,000 adults (1992) more than 20,000 adults (1993)
Isla San Andres Cave	Jalisco, Mexico	non-maternity	more than 50,000 adults
Cueva “La Mina”	Jalisco, Mexico	non-maternity	more than 20,000 adults
Gruta Juxtalahuaca	Guerrero, Mexico	maternity	ca. 2,000 adults
Cueva “Rancha Tempisque”	Chiapas, Mexico	maternity	
Cueva “La Capilla” – San Antonia Mine	Baja California Sur, Mexico	maternity	ca. 20,000 adults and young
Cueva Mulege	Baja California Sur, Mexico	maternity	

Loss of agaves by grazing, agricultural harvest, and development has reduced foraging habitat for lesser long-nosed bats in Arizona and elsewhere in its range. Loss and disturbance of roost sites also pose a significant threat to lesser long-nosed bats and can occur through:

- Recreational caving and mine exploration;
- Closure of abandoned mines for hazard abatement;
- Renewed mining;
- Vandalism; and
- Exclusion of bats.

Efforts are underway in some locations to protect known and potential roosts. For example, at three large maternity colonies in Arizona, various measures have been implemented to protect the utility of the roosts. Several caves and mine adits in southeastern Arizona have been gated with interpretive signs placed nearby in an effort to protect the suitability of these sites for roosting. Colossal Cave at the base of the Rincon Mountains is developed for tourism, but recently steps have been taken to restore parts of the cave in an effort to attract lesser long-nosed bats to use it as a maternity roost, as they did until the 1960s. It is uncertain, however, whether bats will re-occupy a site once it has been abandoned. Cave of the Bells in the Santa Rita Mountains was documented as occupied by lesser long-nosed bats from 1987 through 1989. In September 1989, a ‘test’ bat gate was installed on the cave, after which the number of bats rapidly dwindled. A permanent gate was installed during the winter and spring of 1990; however, no bats returned that year and none have been documented using the cave since (USFWS 1995).

4.2.2 Ecology

LIFE HISTORY

Lesser long-nosed bats are migratory. In September and October, they migrate to Mexico, where they breed and spend the winter. Females return to Arizona pregnant as early as the second week in April. In late April through late July, pregnant females congregate at traditional roost sites, give birth and raise their young. Maternity colonies may number in the hundreds or thousands and in a few places in the tens of thousands. Males form separate, smaller colonies. Females give birth to one young each year in May. Young can fly by the end of June. Maternity colonies break up by the end of July, at which time females and young move to higher elevation areas (up to about 5,500 feet).

HABITAT REQUIREMENTS

Habitat associations of the lesser long-nosed bat vary seasonally in Arizona. From April to July, the lesser long-nosed bat is known to occupy Semidesert Grasslands and Sonoran Desertscrub at elevations below 3,500 feet (AGFD 2003a). From July to late September/early October, the bats migrate to Madrean evergreen woodland (oak transition regions) at elevations up to 5,500 feet (AGFD 2003a). Within these plant communities, lesser long-nosed bats require two critical resources: suitable day roosts and sufficient concentrations of food plants. The distribution of these resources will determine where these bats specifically occur.

In Arizona, lesser long-nosed bats feed on flowers and the fruits of saguaro and organ pipe cactus (*Stenocereus thurberi*) in early summer and agave flowers later in the summer and early autumn. Nectar, pollen, and fruit of columnar cacti provide nearly all of the energy and nutrients obtained by pregnant and lactating females roosting in the Sonoran Desert in the spring and early summer (USFWS 1995). A few insects may be eaten incidentally when feeding on nectar. In Arizona, Palmer’s agave (*Agave palmeri*) appears to be the only agave used by lesser long-nosed bats. Lesser long-nosed bats have been reported to visit hummingbird feeders at night in the Huachuca, Chiricahua, and Santa Rita Mountains, along with those in the Greater Tucson metropolitan area. During winter in Mexico, primary food plants as identified by pollen appear to be *Ceiba, Bombax,* and *Ipomoea*. The spring migration of the lesser long-nosed bat from central Mexico northward is thought to follow the sequential blooming of certain flowers.

Lesser long-nosed bats leave daytime roosts about an hour after sunset to feed. After feeding, they fly to night roosts, which may be different from day roosts, to rest and groom. As they groom, they remove the pollen sticking to their fur with their claws and then lick it off their claws. This ingested pollen provides proteins and other nutrients not obtainable from nectar.

It is not yet clear how important this bat is as a pollinator of saguaros and the agave species with which it is associated in Arizona, since populations of these plants also exist well outside the known range of this bat. Despite several characteristics of chiropterophily, diurnal insects appear to play an important role in pollination of *A. palmeri*.

For day roosts, the lesser long-nosed bat uses caves, mine tunnels, and occasionally, old buildings. This bat appears to be the most dependent of the North American bat species on the availability of inactive mines, and most Arizona records are from inactive mines. Proximity to humans does not necessarily pose a threat to this species (USFWS 1995). Characteristics that render potential roost sites “suitable” for lesser long-nosed bats are unclear, but maternity roosts tend to be very warm and poorly ventilated, at least where the young are actually raised. These characteristics could reduce the energetic requirements of adult females while they are raising their young (USFWS 1995). Another factor that may influence roost suitability is interactions with other bat species. Lesser long-nosed bats have been documented sharing roost sites with up to four other bat species; however, it typically roosts separately from the other bats, such as by moving deeper into the cave or mine to roost (USFWS 1995). At the Patagonia Bat Cave, lesser long-nosed bats do not arrive in significant numbers until late July, after a large maternity colony of *Myotis velifer* has moved on from the site (USFWS 1995).

Like many other bats, individuals of *Leptonycteris* use night roosts for digesting their meals. Night roosts can be the same roosts used during the day or bats may use other caves or mines, or even rock crevices, trees and shrubs, and occasionally, abandoned buildings (USFWS 1995). The extent to which night roosts represent essential habitat in this species is currently unknown.

The choice of roost sites and migration routes are also influenced by proximity to suitable foraging habitat. The availability of any roost site is likely the most critical consideration; however, the suitability of that site and its ability to support bat populations over the long-term depends on the availability and persistence of sufficient foraging habitat nearby (USFWS 1995).

4.2.3 Baseline Conditions

PLANNING AREA POPULATION STATUS

According to HDMS (AGFD 2003a), there are no known roost sites within the Avra Valley planning area; the nearest known roost site is approximately 45 miles to the northwest. Historic records indicate populations previously existed in the Picacho Mountains (last observed in 1998) and the Santa Catalina Mountains (last observed prior to 1986). Within Pima County, the largest known maternity roost in North America is found in an abandoned mine adit in Copper Mountain at Organ Pipe Cactus National Monument (County 2000a).

HABITAT IN AND NEAR THE PLANNING AREA

Suitable roost sites are not believed to occur in the City, but Sonoran Desertscrub habitat within the City limits provides potential foraging habitat for lesser long-nosed bats (County 2000b).

SDCP Habitat Model. A habitat model for the lesser long-nosed bat was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following four primary variables:

- Elevation;
- Slope;
- Carbonates; and

- Vegetation.

A series of categories was assigned to each of these variables, and each category was ranked as 0, 1, 2, and 3, with 0 indicating that the category provides no habitat value and 3 indicating that the category provides high habitat value. The three variables were combined to provide an overall habitat value for a given area (Table 4.2-2).

Table 4.2-2. Habitat Potential Ratings for Characteristics of the Variables Used in the Lesser Long-Nosed Bat Habitat Model in the SDCP

Variable/Category	Habitat Potential Rating
Elevation	
194 to 400 meters	2
401 to 600 meters	2
601 to 800 meters	2
801 to 1000 meters	2
1001 to 1200 meters	2
1201 to 1400 meters	2
1401 to 1600 meters	2
1601 to 1800 meters	2
1807 to 2000 meters	2
Slope	
Moderate	3
Steep	3
Flat within ½ mile of Moderate to Steep Slopes	2
Flat within 2 miles of Moderate to Steep Slopes	1
Carbonates	
Carbonates	2
Area within 1 mile of carbonates	1
Vegetation	
Piñon-Juniper (122.41)	1
Pine (122.82)	1
Encinal (Oak) (123.31)	1
Oak-Pine (123.32)	1
Manzanita (133.32)	1
Mixed Evergreen Sclerophyll (133.36)	1
Mixed Grass-Scrub (143.15)	1
Shrub-Scrub Disclimax (143.16)	1
Paloverde-Mixed Cacti (154.12)	2
Urban (999.2)	2

Source: Recon (2002) *Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan*.

Avra Valley HCP Lesser Long-Nosed Bat Habitat Model.

The LLNB habitat model for the Avra Valley planning area is based on vegetation structure needed for foraging. According to Scott Richardson, USFWS, LLNB forage through native vegetation within riparian areas (City of Tucson 2007). As such, the CFPO over-wintering / WYBC habitat models were used for the LLNB. Figure 4.2-2 shows the potential suitable habitat for the bat within the planning area, of which there are 2,097 acres. Since CFPO (for over-wintering) and WYBC have the same habitat requirements within the planning area as the LLNB, the potential suitable habitat is identical.

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

The nearest known maternity colony is approximately 45 miles northwest of the City (Old Mammon Mine), although historical records indicate that there were maternity colonies approximately 30 miles to the northwest (Picacho Peak) and 5 miles east of Tucson (Colossal Cave). Known non-maternity sites are located approximately 20 miles northeast of Tucson (Santa Catalina Mountains), 15 miles south of Tucson (Cave of the Bells), and 5 miles east of Tucson (Box Canyon crevice) (USFWS 2000a, 2002b, 2002c). The nearest individual was documented in the Santa Catalina Mountains, within Tucson's northeastern boundary. All of the known roost sites in Pima County are protected by land management agencies and large areas of potential forage habitat can be found within the various national Parks, Monuments, and Wildlife Refuges (County 2000a).

There is little potential for colonies to occur in Tucson. The Santa Catalina Mountains extend into Tucson, but the areas within the range having significant mining activity are located outside the City's boundary. The Tortolita Mountains, which are located just north of Tucson, have no history of significant mining activity and there are no known mine tunnels that could be used as maternity roosts by the bats. The Tucson Mountains extend into Tucson, but this area also has no history of mining activity and no documented bat records. The northern end of the Santa Rita Mountains extend into the southern end of Tucson, but the areas within the range having significant mining activity are located south of Tucson.

The foraging radius of *Leptonycteris* bats may be on the order of 30 to 60 miles. Based on this information, portions of Tucson provide foraging habitat for lesser long-nosed bats. The extent of use of the Tucson area by foraging bats has not been determined; however, given the distance of foraging habitat in the City from the nearest known occupied roosts (45 miles), the level of use is likely low.

Local and regional movements of lesser long-nosed bats are largely unknown. However, given the City's location and the fact that the City appears to support suitable foraging habitat for the bats, Tucson could serve as a corridor for movement between roosts in the Slate, Santa Catalina, and Santa Rita Mountains, as well as for seasonal migrations.

In early 2007, USFWS staff addressed the Technical Advisory Committee with regard to the status of LLNB within the Avra Valley HCP planning area. Scott Richardson (USFWS) reported that the species does occur within the planning area and that there is potential for incidental "take" to occur. He added that in terms of take, the needs of LLNB are: 1) roost sites (maternity, transition, night roosts); 2) foraging resources (pollen, nectar, saguaro fruits, agave nectar and pollen, and hummingbird feeders); and 3) habitat connectivity (ability to move between forage resources and roosts). Since there are roost sites and foraging resources on either side of Avra Valley, it is important appropriate vegetation be present within the Avra Valley corridors. The species need these corridors to move between sites . He added that any disturbance that prevents movement through movement corridors (e.g. fragmentation of washes and drainages) would constitute "take." (City of Tucson 2007)

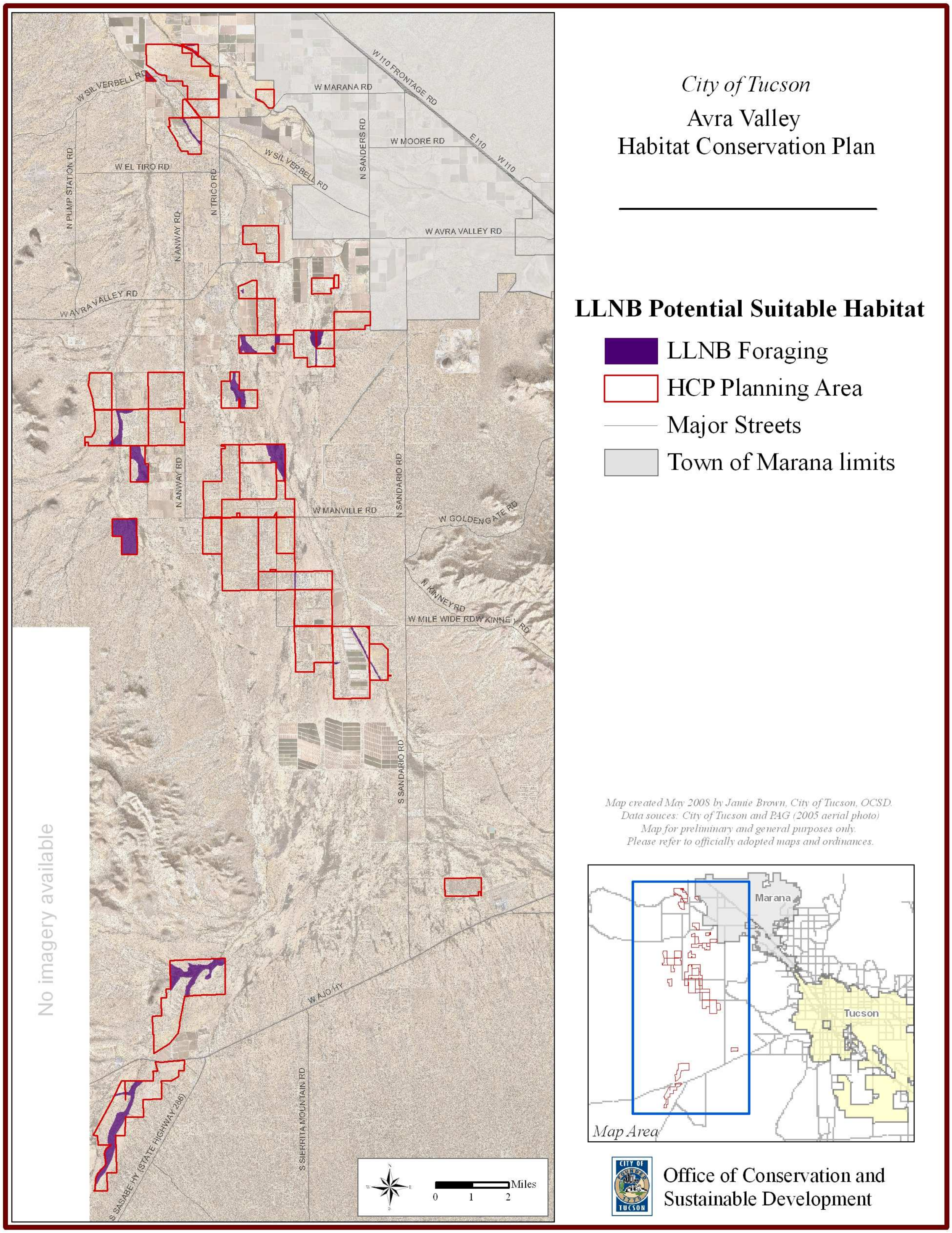

Figure 4.2-2. Lesser long-nosed bat existing potential habitat.

4.2.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

Potential threats and stressors for the lesser long-nosed bat are detailed in table 4.2-3.

Table 4.2-3. Potential and Current Threats and Stressors for Lesser Long-Nosed Bat

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Caves or mines act as maternity roost sites for pregnant females arriving from winter roosts in Mexico and northern South America. Birth and lactation are likely to coincide with peak columnar cacti flower availability.
Foraging	As highly specialized nectar-, pollen-, and fruit-eaters, the bat depends on the resources of saguaros and agave species. The bat will forage over great distances, but prefers to conserve energy resources by foraging as close to roosts as possible. Limited data collected in 2006-2007 show some bats will travel 70km round trip to forage at hummingbird feeders. Preliminary telemetry studies suggest that the bat may avoid urban areas, preferring to travel around highly- urbanized areas or along wash/river corridors where there is less light and lower density development.
Wintering	The species winters in Mexico and northern South America. Winter roosts are generally caves or mines. Vandalism of winter roosts is a significant threat to the bat.
Migratory stops	Caves and mines are used as roosts during migration.
Roost preferences	Caves and mines are extremely important as roosts for this bat.
Habitat Alteration	
Vegetation composition/density	Columnar cacti and agaves provide forage resources for the bat.
Invasive plant species	The spread of buffelgrass can alter fire regimes within the bats foraging habitat. In general, buffelgrass increases the chances of wildlife outbreak, which could destroy native forage plants.
Drought	Can lead to failure of saguaro and agave blooms, important forage for this species. Some bats may be using nectar from hummingbird feeders as an alternate food source when stressed by drought conditions
Edge effects	Inconclusive. However, preliminary telemetry studies suggest that the bat avoids highly urbanized areas or areas with high amounts of artificial lighting.
Breadth of resource use	The bat is a highly specialized nectar-, pollen-, and fruit-eater that depends on the resources of columnar cacti and agave species. Decreases in the availability of these resources can contribute to population decline or changes in forage areas, movement patterns and seasonal chronology.
Species Characteristics	
Behavior traits	The bat is sensitive to disturbance at roosts. Gates over roost caves and mines to keep humans out, though effective for many bat species, may deter this bat.
Fecundity	The number of young produced and the number of pregnancies per year are unconfirmed though one young per year is likely.
Off-site mortality – from surrounding land uses	The bat could be driven from area by renewed mining, urban expansion, and human disturbance of roosts
Inter- and Intraspecific Factors	
Predation	Barn owls have been observed preying on the bats at maternity roosts. Screech owls, great-horned owls, barn owls, coyotes, bobcats, ringtails, skunks, and snakes are likely predators
Interspecific Competition	Herbivory on agave shoots by wildlife such as ungulates can decrease foraging resources
Intraspecific Competition	Decreases in foraging resources can lead to competition among bats.
Anthropogenic Factors	
Fire threat	Wildfires can destroy foraging resources. However, a study has shown that fire can increase the flower and fruiting potential of forage plants in the short term.
Grazing	Herbivory on agave shoots by livestock can decrease forage resources.
Collection/hunting	Collection of agave in Mexico for bootleg tequila leads to a decrease in forage resources. Untrained or unscrupulous researchers handling the bat can lead to mortality.
Direct take/mortality	Vampire bat control measures in the bats wintering range outside the U.S. often lead to incidental take of lesser long-nosed bats.
Light	Artificial lighting may impact bat movements near urban areas. However, more research is needed.
Recreation/Movement	Roosts can be disturbed by caving, vandalism, and undocumented aliens seeking cover, which can lead to roost abandonment.

Table 4.2-3. Potential and Current Threats and Stressors for Lesser Long-Nosed Bat (continued)

Anthropogenic Factors (cont.)	
Domestic/feral animals	Domestic/feral animals may affect bats if they are present in roost sites.
Feeding	Hummingbird feeders provide energy resources devoid of protein and other nutrients.
Fear	Stories, legends, and the portrayal of bats in popular culture can lead to indifference or negative attitudes toward bat conservation, despite this species' importance as a pollinator.
Connectivity	
Fragmentation	Studies suggest that the bat prefers to forage as close to the roost as possible to preserve energy resources. However, they will travel miles in search of forage. Fragmentation increases the distance to forage plants causing the bat to expend more energy in search of food. As the bats migrate north from Mexico, columnar cacti provide the primary food sources.

CURRENT MANAGEMENT RECOMMENDATIONS

Protecting, monitoring, and surveying major roost sites along with protecting foraging areas and food plants are listed as the first two recovery actions proposed in the USFWS Lesser Long-nosed Bat Recovery Plan (U.S. Fish and Wildlife Service 1997). As loss of potential foraging corridor habitat poses the most significant threat to lesser long-nosed bats in the Avra Valley HCP planning area, management recommendations should include:

- Configuration of development in a manner that preserves the highest quality habitat and maintains connectivity to adjacent habitat, particularly roost sites; considerations should be given to the spatial needs of the species, breeding requirements, dispersal patterns, and landscape-scale movement needs, habitat conditions, forage constraints, and home range requirements;

- Protection measures for those lands modeled as potential lesser long-nosed bat roosting and foraging habitat by USFWS staff.

In addition, the *Arizona Bat Conservation Strategic Plan* outlines a number of management strategies for protecting this and other bat species in the state (Hinman and Snow 2003). These recommendations include identifying, protecting, and enhancing key roosting, feeding, and drinking resources for bats and developing education materials to reach important audiences.

Priority actions to accomplish these management goals include:

- Protect 100% of all lesser long-nosed bat roosts in the permit area;
- For bridges and culverts known to support roosting bats, protect 100% of these sites. For other bridges and culverts, incorporate bat-friendly bridge and culvert designs into 25 percent of new highway structures that are potential roosts because of macrohabitat features, and retrofitting 25 percent of existing structures with roost potential;
- Identifying and protecting foraging areas for bats near key roost sites;
- Protecting, restoring, maintaining, and monitoring key open-water drinking sites;
- Protecting, restoring, maintaining, and monitoring key flight and migratory corridors;
- Establishing bat education programs in communities located near important bat roosts or other habitats; and
- Developing and implementing conservation and education programs that would educate residents about bats living in urban environments.

4.2.5 Potential Impacts of the City s Proposed Activities

DIRECT EFFECTS

Lesser long-nosed bats roost in caves and mines. No known roost sites occur in the City and no suitable roost sites are expected to occur in areas of projected urban development. Therefore, disturbance or destruction of roosts during construction activities is not anticipated.

INDIRECT EFFECTS

Lesser long-nosed bats can be adversely affected indirectly by land development. Specifically, lesser long-nosed bats are vulnerable to disturbance at roost sites. However, because the City does not support suitable roost sites for lesser long-nosed bats, indirect effects are not anticipated. Noise and other construction-related disturbance could cause individual bats to move to other foraging areas, potentially increasing energetic demands of bats. However, since bats forage at dusk or at night when construction activities typically are not being conducted, there is little potential for disturbance. Given the distance of the HCP area from known roosts, the number of bats that potentially would be directly affected by land development is probably low.

POTENTIAL HABITAT CHANGES IN THE PLANNING AREA

The loss of potential foraging habitat for lesser long-nosed bats in the Avra Valley planning area due to land development for water infrastructure projects has the potential to result in take.

POPULATION-LEVEL EFFECTS

Urban development in the City could reduce the potential foraging habitat for lesser long-nosed bats associated with five present or historic roosting locations, including the Picacho Mountains, Slate Mountains/Old Mammon Mine, Santa Catalina Mountains, Cave of the Bells, and Santa Rita Mountains. However, for at least two of these sites, Tucson is at the extreme end of the potential foraging range of these bats (approximately 40 miles).

The potential for population level effects to lesser long-nosed bat will depend on whether roosting sites or foraging habitat is the more important limiting factor for these bats. For most of the known roost sites (both current and historic), foraging habitat is present closer than that in Tucson. Also, the level of use of habitats in Tucson by foraging and migratory bats is unclear. However, if foraging habitat outside of Tucson is reduced, then foraging habitat within Tucson could become more important and reductions in this habitat from urban development could contribute to reductions in bat populations that roost elsewhere.

4.3 Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*)

4.3.1 Population Status and Ecology

RANGE AND DISTRIBUTION

The ferruginous pygmy-owl (*Glaucidium brasilianum*) has a range that extends from the southern U.S. (Arizona and Texas) south to central Argentina (Cartron et al. 2000a). The cactus ferruginous pygmy-owl

(CFPO; *Glaucidium brasilianum cactorum*) is the northernmost occurring of several subspecies of the ferruginous pygmy-owl (Cartron et al. 2000a).

The current distribution of CFPO in Arizona is poorly understood. Historically, CFPO occupied areas of south-central Arizona from New River (approximately 35 miles or 56 kilometers north of Phoenix), south to the U.S.–Mexico border, west to southern Yuma County, and east to the San Pedro River and the confluence of the Gila and San Francisco rivers (approximately 100 miles or 161 kilometers northeast of Tucson) (USFWS 2003b; Cartron et al. 2000a) (Figure 4.3-1). Currently, the Arizona population appears to have a patchy distribution, with most CFPOs located in one of four general areas: northwest Tucson and southern Pinal County, OPCNM, the Tohono O'odham Nation, and Alter Valley (Richardson et al. 2000). The species may be extirpated from portions of its historical range, including the lower and middle Gila River, the Santa Cruz River near Tucson, the Rillito Creek, and the Salt River near Phoenix (Cartron et al. 2000c). The patchy, dispersed nature of the CFPO population in Arizona suggests that the overall population may function as a metapopulation, with local groups of owls functioning as subpopulations (USFWS 2003b).

TAXONOMIC UNIQUENESS

The ferruginous pygmy-owl is divided into four distinct population segments: Texas, eastern Mexico, Arizona, and western Mexico (USFWS 1997). The eastern (Texas and east Mexico) and western (Arizona and west Mexico) populations are separated by the basins and mountain ranges of the Chihuahuan Desert in the U.S., and by the Sierra Madre Occidental and Oriental ranges and the Mexican Plateau in Mexico (Cartron et al. 2000a). The non-migratory nature of the CFPO subspecies suggests that genetic mixing across these barriers is infrequent. In addition to the likely geographic isolation of the eastern and western populations, the two populations utilize floristically dissimilar habitats. Finally, significant morphological differences have been identified between Arizona and Texas owls, further supporting the genetic distinctness of the two populations (USFWS 1997). A recent genetic study provides strong evidence that the eastern and western populations of ferruginous pygmy-owl are genetically distinct units (Proudfoot and Slack 2001). The further separation of the two populations into northern and southern segments is less certain. The genetic distinction between the Arizona and western Mexico populations (and the Texas and eastern Mexico populations) is the subject of substantial and ongoing controversy. Proudfoot and Slack (2001) did not find any evidence of genetic isolation between distinct populations in the U.S. and those immediately across the border in northwestern or northeastern Mexico. Furthermore, the low haplotypic diversity and distinct clade occurring in Northwest Tucson suggests current separation between populations in Northwest Tucson and populations in the Altar Valley, Sonora, and Sinaloa.

POPULATION STATUS AND THREATS

Federal Status. The endangered status of the CFPO has been controversial and subject to years of litigation. In March 1997, the Arizona population of the CFPO was federally listed as endangered and as a distinct population segment (DPS) (USFWS 1997). In January 2001, the National Association of Homebuilders (NAH) sued to vacate the listing on the basis that the DPS designation for the Arizona population was not valid. The District Court, in September 2001, found that the DPS designation, and as a result the listing, was consistent with USFWS policies. Then, in March 2003, the NAH appealed the District Court decision to the Ninth Circuit Court. Five months later, the Ninth Circuit Court declared that the USFWS was arbitrary and capricious in listing the Arizona population of the CFPO and remanded the listing back to the District Court for further proceedings (NAHB 2003). In June 2004, the District Court left the listing in place and referred the listing back to the USFWS for further review based on information gathered since 1997. In August 2004, the NAH appealed the District Court's June order to the Ninth Circuit Court of Appeals. The USFWS provided an update of their reconsideration at the end of January 2005 (NAH 2004). In September 2005, the USFWS announced its proposed rule to remove the

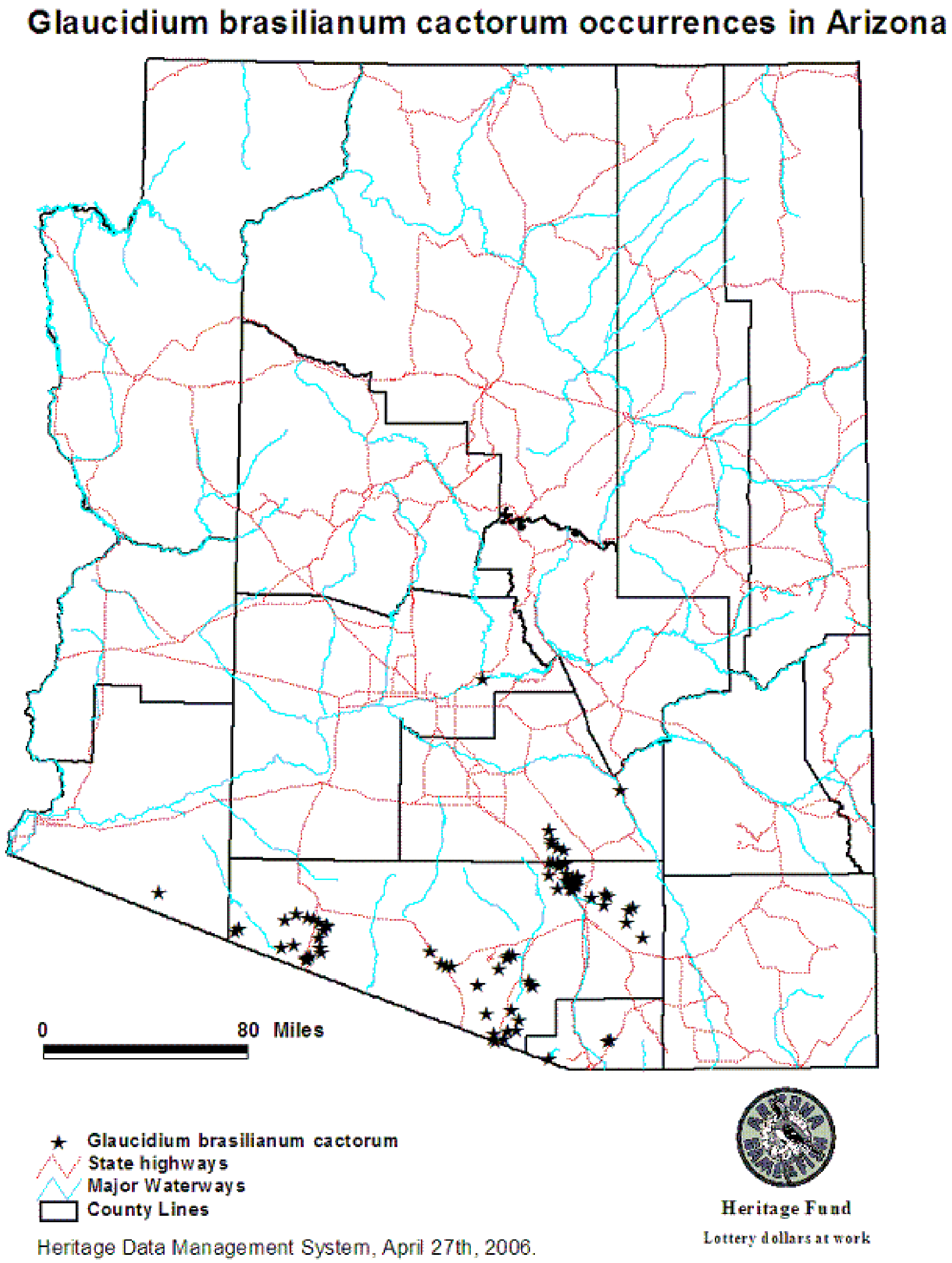

Figure 4.3-1. Distribution map of cactus ferruginous pygmy-owls in Arizona based on locations reported in the HDMS. Source: AGFD.

Arizona DPS of CFPO from the federal list of endangered and Threatened Wildlife (USFWS 2005). On April 14, 2006, the USFWS announced that the Arizona population had been de-listed, effective May 15, 2006 (USFWS 2006). The legal status of the CFPO continues to be uncertain.

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In July 1999, USFWS designated approximately 740,000 acres of Critical Habitat in Arizona. This designation, along with the listing itself, was challenged in the January 2001 lawsuit described above. In September 2001, a Federal judge vacated the Critical Habitat and remanded the designation back to USFWS for a new analysis of economic impacts. In 2003, USFWS re-proposed 1.2 million acres of Critical Habitat (USFWS 2002b). The USFWS also announced in 2005 its intention to eliminate its currently designated Critical Habitat and withdraw its proposed new Critical Habitat (USFWS 2005). On April 14, 2006, USFWS announced that it would remove CFPO from the federal list of endangered and threatened wildlife on May 15, 2006; on that date the elimination of CFPO Critical Habitat also became effective (USFWS 2006).

Texas Population and Status. Although threatened status was proposed for the Texas population of CFPOs, this population was determined to be stable and have a lower level of threat than the Arizona population. Therefore, listing of the Texas population was not warranted (USFWS 1997). One estimate of the CFPO population in Texas suggests that, across Brooks, Kenedy, and Willacy counties, there are 1,308 owls occurring in live oak-mesquite habitat (Wauer et al. 1993). Another study estimates that between 745 and 1,823 individuals occur in Kenedy County alone (Mays 1996).

Mexico Population and Status. At the time of the listing, the USFWS noted that it would continue to review the status of CFPO populations in Mexico and evaluate whether one or more of these populations should be proposed for listing (USFWS 1997). There is limited information about the population status of CFPOs in Mexico. Russell and Monson (1998) suggested that, based on their personal observations and anecdotal information, populations in Sonora, Mexico had not declined. Currently, the CFPO is thought to be relatively abundant in northern Sonora. Flesch and Steidl (2000) looked at CFPO populations just south of the U.S. border throughout Sonora, Mexico. They observed 240 owls (208 males and 32 females) on 191 transects surveyed between February and March 2000, the early part of the breeding season. Another 22 possible detections were made during the surveys. The presence of a pair was documented at only 12 sites, with evidence of pair occupancy at another five sites. In all, only four occupied nest cavities were recorded. In addition to the survey results, another 39 incidental CFPOs detections were recorded. Eight of these owls were female and 31 were male. Three sites had confirmed pair occupancy, with two of these sites having occupied nest cavities. The densities of owls recorded during the survey ranged from 1.80 owls per 10,000 hectares (61,000 acres) to 0 owls per 10,000 hectares (61,000 acres), with an average of 0.17 owls per 10,000 hectares (61,000 acres) (Flesch and Steidl 2000).

Arizona Population Status and Threats. There has been a historical decline in the species' range in Arizona (County 2000a). The extent of this population decrease is unknown, in part due to the lack of quantified historical records. Historically, CFPO in Arizona was most commonly reported in cottonwood-mesquite forest and mesquite woodlands. In recent years, CFPOs have been observed primarily in the Arizona Upland Subdivision of the Sonoran Desertscrub biome (USFWS 2003b).

The general understanding is that CFPO populations in Arizona began to decline after about 1950, possibly as a result of the increasing loss of riparian habitat caused by lowered water tables, loss of perennial flows in many streams and rivers, invasion of exotic vegetation such as tamarisk (*Tamarix* spp.), and physical changes to river channels, banks, and floodplains. Many riparian areas, however, had not been surveyed prior to being impacted by human activities, so it is possible that the population decline started much earlier in the 20th Century (Johnson et al. 2000).

Formal surveys for the CFPO did not begin in Arizona until 1993. Although CFPO records in Tucson and OPCNM date back to 1872 and 1949, respectively, for many other areas, such as on the Tohono O'odham Nation, few or no historical data exists (Johnson et al. 2000). Even after formal surveys began, the intensity of those efforts was insufficient to provide a good estimate of the number of CFPOs in Arizona. Only after the listing in 1997 did survey efforts increase to the point that a better picture of the population status begin to emerge (Richardson et al. 2000).

The total number of CFPOs in Arizona is still unknown. Survey and monitoring documented 37 adult CFPOs in 1999, 30 in 2000, 36 in 2001, 29 in 2002, 21 in 2003, 20 in 2004, and 20 in 2005 (USFWS 2003b; S. Richardson, USFWS, pers. com.; D. Abbate, AGFD Research Branch, pers. com.). It is probable that there are more CFPOs in Arizona, as large tracts of potentially suitable CFPO habitat have not been surveyed (USFWS 2002b; Richardson et al. 2000). In 1999, the last year for which CFPO survey data was published, 28 owl territories were identified in Pinal and Pima counties. Eleven of these territories had documented breeding activity, with all nests successfully fledging young (although one nest failed after fledging). In total, 32 young successfully fledged in 1999, with 16 known to survive through dispersal (Abbate et al. 2000). Surveys indicate that there are fewer than 50 territories in the State (outside Tribal lands) (S. Richardson, USFWS, pers. comm.).

Three general factors were identified as the basis for listing of the Arizona population segment: 1) present or threatened destruction, modification, or curtailment of the species habitat or range; 2) inadequacy of existing regulatory mechanisms; and 3) other natural or man-made factors affecting its continued existence. Regardless of uncertainty related to habitat use by the CFPO in Arizona, loss of habitat is generally regarded as the single largest contributor to the decline in owl populations. Anecdotal evidence from both Arizona and Texas indicates that population declines in both locations coincided with the loss of habitat. Relatively large populations of CFPOs can still be found in Texas where owl habitat has been preserved (Johnson et al. 2000).

Although loss of riparian habitat may have been the primary threat to CFPOs in Arizona, the recent loss and fragmentation of upland vegetation from large-scale residential and commercial developments has also been identified as an important threat (USFWS 2003b). Development pressure is seen as the primary threat to conservation of habitat for this species in Northwest Tucson (USFWS 2002b). Activities that may affect habitat include: clearing vegetation, indirect effects of urbanization, agricultural encroachment, road-building, high-impact recreation, water diversion or impoundment, channelization of drainages, groundwater pumping, livestock grazing, and hydrologic changes resulting from various land use practices (USFWS 2003b).

CFPOs are susceptible to predation from a variety of species, such as great horned owls, Harris' hawks (*Parabuteo unicinctus*), Cooper's hawks (*Accipiter cooperi*), screech owls (*Otus* sp.), and domestic cats (USFWS 2002b, 2003b). Other threats include direct and indirect human-caused mortalities, such as collisions with cars, glass windows, fences, and power lines; illegal dumping of toxic waste; and wildfire (USFWS 2003b). Additional natural and human induced factors that could affect the subspecies include low levels of genetic variation, possible contamination from pesticides, potential competition with other birds for nesting cavities, concentration of recreational birding activities at remaining known locations, disease (e.g. *Trichomoniasis*), and nest predation (USFWS 2002b, 2003b). Human activities near nest sites at critical periods of the nesting cycle also can cause CFPOs to abandon their nests (USFWS 2003b). CFPO habitat also can be compromised by the presence of barriers to movement, including roads, interstates, canals, certain types of fencing, and alterations of functional drainages (County 2001).

4.3.2 Ecology

LIFE HISTORY

CFPOs are primarily diurnal with crepuscular tendencies, i.e. most activity occurs during daylight hours, with peaks at dawn and dusk (USFWS 2003b). A CFPO typically flies in quick bursts, moving only a short distance from one lookout point to another (Cartron et al. 2000b). CFPO typically hunts from perches in trees with dense foliage, using a perch-and-wait strategy. CFPO also hunts by inspecting tree and saguaro cavities for other nesting birds, and possibly bats. Its diverse diet includes birds, lizards, insects, and small mammals; however, the owls do use different groups of prey species on a seasonal basis (USFWS 2002b). CFPOs have never been observed directly drinking water, likely meeting much of their biological water requirements through consumed prey (USFWS 2003b).

CFPOs are considered non-migratory throughout their range (USFWS 2002b). They are highly territorial, with territory sizes between three and 57 acres during the breeding season and winter home ranges as large as 279 acres (County 2001; USFWS 2003b). A 280-acre home range is currently considered necessary for CFPOs to meet their life history requirements on an annual basis (USFWS 2003b). Based on telemetry data, it appears that the larger winter range of CFPOs represents an expansion of the breeding territory and does not involve a seasonal shift of territory from one location to another (S. Richardson, USFWS, pers. comm.).

CFPOs typically nest as yearlings and both sexes breed annually thereafter. Territories normally contain several nest-roost cavities from which a responding female selects a nest. Hence, cavity density could be a fundamental criterion for habitat selection (USFWS 2003b).

In Arizona, the courtship and nesting period runs from February to May (USFWS 2003b). Clutch sizes range from three to seven eggs (County 2001). One clutch per year is typical (USFWS 2003b); however, a second clutch may be laid if the first one fails (County 2000). Juveniles typically disperse from natal areas between July and August and do not appear to defend a territory until September. Direction of dispersal appears to be random (USFWS 2003b) and a juvenile CFPO has been documented dispersing over 100 miles (161 kilometers) (D. Abbate, AGFD, pers. comm.). Once dispersing male CFPOs settle in a territory, they rarely move out of their home range. Unpaired females may continue to move until the subsequent breeding season (USFWS 2002b). CFPOs exhibit a high degree of site fidelity once territories and home ranges have been established (USFWS 2002b). Behaviorally, the option to seek alternative areas outside the home range appears limited, particularly for males (USFWS 2003b).

Little is known about the rate or causes of mortality in CFPOs or their life expectancy. The average or maximum life span of a CFPO is not known; however, the longest an owl has been tracked in Arizona is five years. Glen Proudfoot suspects there is a CFPO in Texas that could be as much as seven years, but the longest documented life span in that state is five years (S. Richardson, USFWS, pers. comm). In 1999, AGFD reported three instances of adult mortality and 11 instances of actual or presumed juvenile mortality. One adult owl appeared to have broken its neck in a collision with a fence and the other two adults were suspected victims of predation (Abbate et al. 2000). The five confirmed juvenile deaths were from predation (1 juvenile), injuries resulting from wind damage to the nest saguaro (3 juveniles), and unknown causes (1 juvenile) (Abbate et al. 2000).

HABITAT REQUIREMENTS

The habitat requirements of the CFPO are not fully understood. Habitat use by the CFPO varies from Arizona to Texas to Mexico. In Texas, they are typically found in coastal-plain oak associations, mesquite bosques, and Tamaulipan thornscrub. In eastern Mexico, they occur in lowland thickets, thornscrub associations, riparian woodlands, and second-growth forests. In western Mexico, the CFPO is commonly found in Sonoran Desertscrub, Sinaloan Thornscrub, Sinaloan Deciduous Forest, riverbottom woodland, cactus forests, and thornforests. As discussed below, in Arizona, habitat use has included cottonwood and mesquite riparian woodlands, upland Sonoran Desertscrub, and Semidesert Grasslands.

Although the plant communities in Texas and Arizona differ, their similarities may help identify those characteristics most significant for the CFPO. The ferruginous pygmy-owl is often associated with thickets and thicket edges in Texas and densely foliated non-native landscape vegetation in Arizona. Another similarity between these diverse communities is the presence of thorny bushes (Cartron et al. 2000a). These similarities may indicate that vegetation structure, rather than composition, is a critical factor in determining the preferred habitat of the owl.

In Arizona, CFPOs historically were most commonly reported in cottonwood-mesquite forest and mesquite woodlands. These mesic riparian forests and associated mesquite woodlands have been nearly eliminated in southern Arizona over the last 100 years, and the reduction of these habitats is thought to have caused a decline in CFPOs over that period (USFWS 2002b). There is some question as to whether the CFPO was exclusively associated with riparian habitat. Early naturalists in Arizona tended to focus their efforts along rivers, so it is possible that the tendency for CFPOs to be documented in riparian areas is primarily an artifact of where survey and collection work took place (Johnson et al. 2003). Advocates for this historic CFPO-riparian association note that numerous expeditions crossed the south and central portions of Arizona without reporting the presence of CFPOs. In the late 1800s, noted ornithologists Charles Bendire and George Breninger made a distinction between elf owl nesting habitat (in upland saguaros) and CFPO nesting habitat (in riparian cottonwoods and mesquites). There are, however, published historic records (1920s to 1950s) of CFPOs in areas with no permanent water source (Johnson et al. 2003). The lack of extensive, quantified historical records makes it unlikely that the debate will ever be fully settled (S. Richardson, USFWS, pers. comm.).

In recent years, CFPOs have been primarily found in the Arizona Upland Subdivision of the Sonoran Desertscrub biome. The Arizona Upland Subdivision is described as low woodlands of leguminous trees with an overstory of columnar cacti and with one or more layers of shrubs and perennial succulents. Over the past several years, owls also have been observed in riparian and xeroriparian (dry washes) areas and in Semidesert Grasslands (USFWS 2003b).

The primary constituent elements of CFPO habitat have been identified as (USFWS 2002b):

1) Below 4,000 feet within the following biotic communities: Sonoran riparian deciduous woodlands; Sonoran riparian scrubland; mesquite bosques; xeroriparian communities; tree-lined drainages in Semidesert Grassland, Sonoran savanna, and mesquite grasslands; and the Arizona Upland and Lower Colorado River subdivisions of the Sonoran Desertscrub.
2) Nesting cavities in trees including, but not limited to, cottonwood, willow, ash, mesquite, palo verde, ironwood, and hackberry with a trunk diameter of 6 inches (15.2 centimeters) or greater (measured at 4.5 feet [1.4 meters] aboveground), or large columnar cactus such as saguaro or organ pipe greater than 8 feet (2.4 meters) tall;
3) Multi-layered vegetation (presence of canopy, mid-story, and ground cover) provided by trees and cacti in association with shrubs such as acacia, prickly pear, desert hackberry, graythorn, etc., and ground cover such as triangle-leaf bursage, burroweed, grasses, or annual plants;
4) Vegetation providing mid-story and canopy-level cover in a configuration and density compatible with CFPO flight and dispersal behaviors; and
5) Habitat elements configured and human activity levels minimized so that unimpeded use, based on CFPO behavioral patterns, can occur during dispersal and within home ranges.

Studies of habitat use in Texas suggest that important habitat characteristics include moderate to dense understory cover (anywhere from 50 percent to 100 percent), the presence of trees large enough to provide cavities, and fewer small trees (Proudfoot et al. 2000). In Arizona, nest sites tend to have a higher degree of canopy cover and higher vegetation diversity than random sites (USFWS 2003b). Relatively dense understory cover could be important for foraging and survival of fledglings (Cartron et al. 2000a) as well as providing protection from extreme climatic conditions (Cartron et al. 2000b).

Preliminary studies suggest that CFPOs in Northwest Tucson use areas with relatively high levels of structural diversity in the suburban/urban interface. Areas of highest concentration of CFPOs are commonly characterized by semi-open or open woodlands, often in proximity to forests or patches of forest. Although CFPOs occupy the same general area year-round, the size of the area used and the composition of vegetation may vary among seasons (USFWS 2003b).

CFPOs are obligate cavity nesters, meaning that they almost exclusively utilize natural cavities or cavities created by other species (Cartron et al. 2000b). Historically, CFPOs in Arizona used cavities in cottonwood, mesquite, ash (*Fraxinus* sp.), and saguaro cacti for nest sites (USFWS 2002b), although some evidence suggests that mesquite (a hardwood species) is less readily excavated and, therefore, is less frequently used in riparian areas than softwood trees (Cartron et al. 2000b). Recently (1996–2002), all but two known nest sites were in saguaro cacti. Of the two non-saguaro nests, one was in an ash tree and the other in a eucalyptus tree.

The general conclusion from these studies is that, in order to support successful reproduction and rearing of young, home ranges should include trees and cacti of adequate size to provide cavities for nest sites and that are in proximity to foraging, roosting, sheltering, and dispersal habitats. Further, adequate cover is needed for protection from climate and predators, and in an appropriate configuration in relation to the nest site.

Some preliminary investigations have been done to determine the degree of development within the home ranges and/or breeding territories of CFPOs. In 2001, 83 percent of known CFPO sites were in undeveloped areas with very little human activity and 17 percent of sites were in areas with some level of low-density development. No CFPOs have been documented in high-density commercial or residential developments. CFPO experts on the Recovery Team calculated the level of vegetation disturbance within the estimated home range (280 acres) at each nest site. The average percent disturbance was calculated to be 23 percent. More recent information from an analysis completed by the AGFD showed an overall disturbance of 33 percent within breeding home ranges. There appears to be a difference in the tolerance of breeding versus non-breeding CFPOs to the level of vegetation disturbance (S. Richardson, USFWS, pers. comm.).

CFPOs require habitat linkages, within and among territories, for movement and dispersal. Habitat linkages consist of continuous cover or patches of trees and large shrubs spaced at regular intervals, to provide concealment and protection from predators and mobbing. These areas also provide shade and cover to moderate temperature extremes (USFWS 2003c).

In their search for mates, food, or territories, dispersing CFPOs may stop temporarily in appropriate over-wintering habitats. For CFPOs, over-wintering habitats are defined as riparian areas that are more extensive in size and support higher vegetation densities—thereby providing greater cover and prey densities—than dispersal habitats. Although saguaros may be present in the vicinity, the presence of saguaros is not a requirement of either over-wintering or dispersal habitats (S. Richardson, USFWS, pers. comm.).

4.3.3 Baseline Conditions

CITY OF TUCSON POPULATION STATUS

While the total number of CFPOs in southern Arizona is unknown, CFPOs have been detected in the following areas (County 2000; S. Richardson, USFWS, pers. comm.; D. Abbate, AGFD Research Branch, pers. comm.):

- Tortolita Fan, northwest of Tucson (documented annually since 1993, with nesting observed from 1995 to 2002; 3 owls observed in 2004; 2 owls observed in 2005, and 1 owl observed in 2006);
- Tucson Mountains (1 owl documented in 1998) and just east of this range;
- OPCNM (documented annually since 1993, with nesting documented from 1998 through 2001; no nesting documented from 2002 to 2005; 1 pair and at least 2 individuals observed in 2006);
- Tohono O'odham Nation (several owls), and;
- Altar Valley (nesting documented annually since at least 1999; 4 pairs observed in 2003 and 2004; 5 pairs observed in 2005)

AGFD Research Branch has conducted radio-tracking studies on selected CFPOs since 1998. In 2003–2004, a female CFPO was tracked crossing Avra Valley, starting in the vicinity of Green Valley, crossing Ajo Highway, and continuing north into Pinal County (S. Richardson, USFWS, pers. comm.; D. Abbate, AGFD, pers. comm.). During the 2004–2005 tracking period, AGFD monitored the movements of a female CFPO that fledged from a nest on ASLD land, in the central portion of the Altar Valley, east of Highway 286. Consistent with other females, this individual moved relatively long distances in search of a mate. Movements were tracked from the onset of dispersal (late July 2004), until December 2004 when the transmitter failed. This female initially moved southeast, passing by the Cerro Colorado Mountains, then briefly south across Arivaca Road and into the canyon-foothills area of the Tumacacori Mountains. It then headed northeast until reaching an area within two miles of its natal territory, where it spent the late summer, fall and winter of 2004. This disperser was recaptured in March 2005 and equipped with a new transmitter. In late March, it began moving north again and eventually crossed to the west side of Highway 286, in the north section of Altar Valley, during 10 and 11 April. After this road crossing, AGFD used a triangulation estimate to determine the CFPO's location within a City-owned parcel

(Duval/Pennzoil Farm) in Section 7, Township 16 South, Range 10 East. To AGFD's knowledge, this location is the first confirmed detection of a CFPO on City property since CFPO was federally listed in 1997. This individual continued its dispersal east, spending some time near Green Valley, and eventually moved west onto the Tohono O'odham Nation, where it was last detected during aerial tracking on June 11, 2005.

HABITAT IN AND NEAR THE PLANNING AREA

Four different approaches have been used to delineate potential habitat for CFPO:

- Critical Habitat;
- Draft recovery areas;
- The Sonoran Desert Conservation Plan habitat model;
- The City of Tucson Habitat Conservation Plan CFPO habitat model.

Proposed Critical Habitat. The areas proposed as Critical Habitat are intended to:

- Protect known locations of CFPOs;
- Include habitat linkages that allow movement and dispersal among the areas supporting CFPOs; and
- Maintain habitat through which CFPOs can move between Mexico and the northern portion of the Arizona range.

Critical Habitat was developed to include the following: recent (since 1997) verified CFPO sites; areas below 4,000 feet (1,220 meters) in elevation that include one or more primary constituent elements related to vegetation; areas included in the average straight-line dispersal distance (5 miles or 8 kilometers) from nest sites; and 4 of the 5 Special Management Areas identified in the draft Recovery Plan (described below). All areas of proposed Critical Habitat fall within the maximum dispersal distance (21.8 miles) from recent, verified owl locations, are below 4,000 feet (1,220 meters) elevation, and include one or more primary constituent element (USFWS 2003c). The Avra Valley HCP planning area encompasses 6,017 acres of proposed Critical Habitat for CFPO (Figure 4.3-2).

Draft Recovery Plan. The draft Recovery Plan identifies eight Recovery Areas (RAs) for CFPO. These areas represent an interconnected system of habitat based on:

- Recent, verified locations of CFPOs;
- More recent historical locations; and
- Habitat with the best chance of supporting breeding CFPO and dispersal (specifically, Arizona Upland Desertscrub, xeroriparian wash vegetation communities, and where appropriate, mesic riparian vegetation).

The RAs include some areas that are not considered currently occupied (i.e. areas more than 21.8 miles from recent, verified locations). Within some RAs, Special Management Areas (SMAs) were identified that need special management because of current or potential threats to the recovery of the CFPO (USFWS 2003c). There are 6,013 acres of recovery areas in the Avra Valley HCP planning area (Figure 4.3-3).

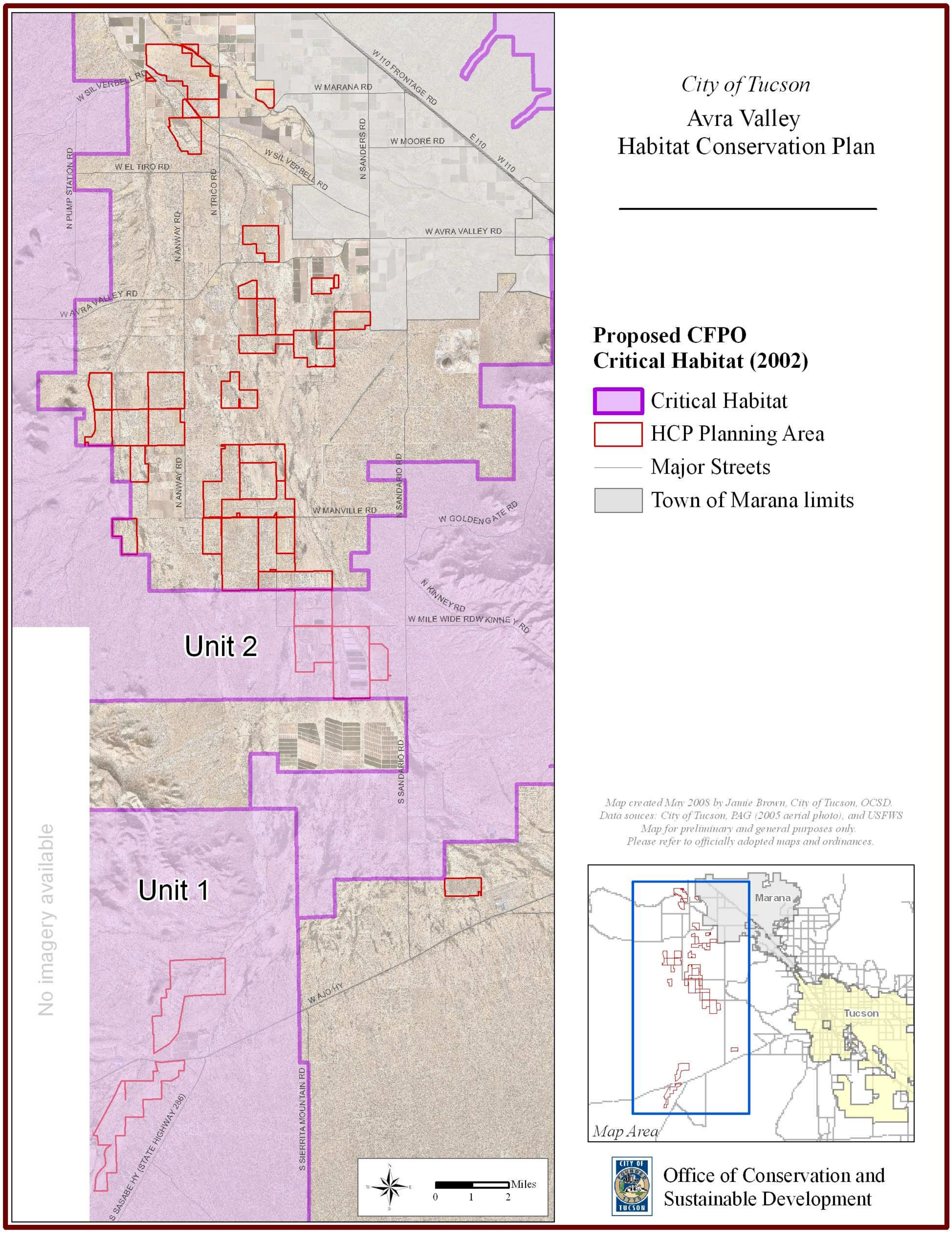

Figure 4.3-2. Proposed CFPO Critical Habitat in the City of Tucson HCP Planning Area (with units indicated).

Sonoran Desert Conservation Plan Habitat Model. The SDCP habitat model for CFPO was based on four primary components:

- Elevation;
- Vegetation;
- Presence of perennial or intermittent streams; and
- Landform characteristics (County 2001).

A series of categories was then assigned to each of these components, and each category was ranked as 0, 1, 2, and 3, with 0 indicating that the category provides no habitat value and 3 indicating that the category provides high habitat value. The four variables were then combined to provide an overall habitat value (Table 4.3-1).

The City HCP CFPO Habitat Model. The City HCP CFPO habitat model was developed through discussions with members of the CFPO Recovery Team and other experts, including representatives of USFWS, AGFD, and University of Arizona. Proposed Critical Habitat and mapped RAs do not capture all potentially suitable habitats within the City HCP planning area, but, on the other hand, the degraded state of the land within the Avra Valley planning area that falls within these designations should be recognized.

To create this habitat model, the team of experts visually identified areas on orthophotos that: 1) are currently suitable as over-wintering habitat for CFPOs; 2) are currently suitable as dispersal habitat for CFPOs; and 3) are not currently suitable habitat but constitute critical connections between existing over-wintering or dispersal habitat and therefore needed to be considered in the habitat conservation planning process. The model recognizes the value of the Avra Valley planning areas to provide connectivity between CFPO populations on the Tohono O'odham Nation and Avra Valley, and Critical Habitat in southern Pinal County and the Northwest Tucson and Tortolita Fan area. Also captured within the model are areas with sufficient vegetation density to offer potential over-wintering habitat for dispersing CFPOs. This over-wintering habitat was identified as areas with characteristics similar to those existing in areas of suitable breeding habitat. As a result, these areas present potential, although highly unlikely, breeding opportunities for the owl.

Based on the City's habitat model, 2,097 acres of potential over-wintering habitat, 1,838 acres of potential dispersal habitat, and 1,289 acres of habitat with potential for dispersal with restoration are predicted to occur in the Avra Valley planning area (Table 4.3-2; see Figure 4.3-4).

Table 4.3-2. Acreage of Each Type of Potential CFPO Habitat in the Avra Valley HCP Planning Area

Habitat Type	Avra Valley (acres)
Over-wintering	2,097
Dispersal	1,838
Dispersal with Restoration	1,289
Total Planning Area Acres	**5,224**

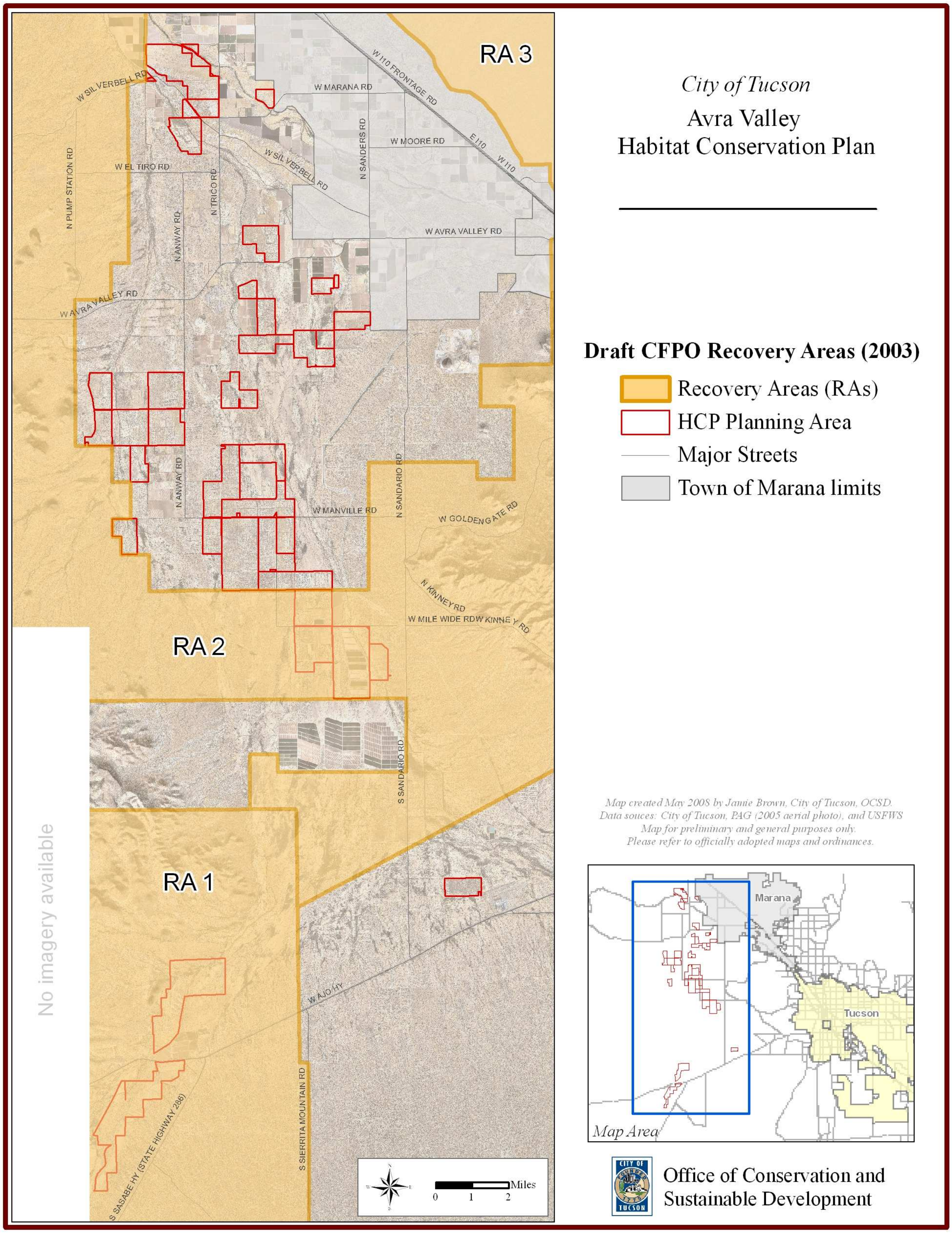

Figure 4.3-3. Draft CFPO Recovery Areas in the City of Tucson HCP Planning Area

Table 4.3-1. Value Ratings for Characteristics of the Variables Used in the SDCP CFPO Habitat Model

Variable/Category	Value Rating
Hydrology	
Intermittent stream	2
Adjacent habitat within ½ mile of intermittent stream	1
Perennial stream	2
Vegetation	
Sonoran Riparian Woodland Xero-riparian mesquite (124.7)	3
Scrub-Grassland Mixed grass-scrub (143.15)	1
Scrub-Grassland Xeroriparian biome (143.10.XR)	1
Sonoran Desertscrub Upland Paloverde-mixed cacti (154.12)	3
Sonoran Desertscrub Xeroriparian Paloverde-mixed cacti (154.12XR)	3
Sonoran Desertscrub Urban Paloverde-mixed cacti (154.12U)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian biome (223.20)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian cottonwood-willow (223.21)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian mixed broadleaf (223.22)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Urban biome (223.20U)	2
Sonoran Riparian and Oasis Forests Meso-riparian mesquite (224.52)	3
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53)	3
Sonoran Riparian and Oasis Forests Urban mesquite (224.52U)	2
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53U)	2
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian mixed scrub (234.71)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian saltcedar disclimax (234.72)	1
Slope	
0%–2%	1
2%–5%	1
Elevation	
195–400 meters	1
401–600 meters	2
601– 800 meters	2
801–1,000 meters	2
1,001–1,200 meters	2
Land Form	
Drainageways	2
Floodplains	2
Terraces	2

Source: Recon (2002) *Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan*.

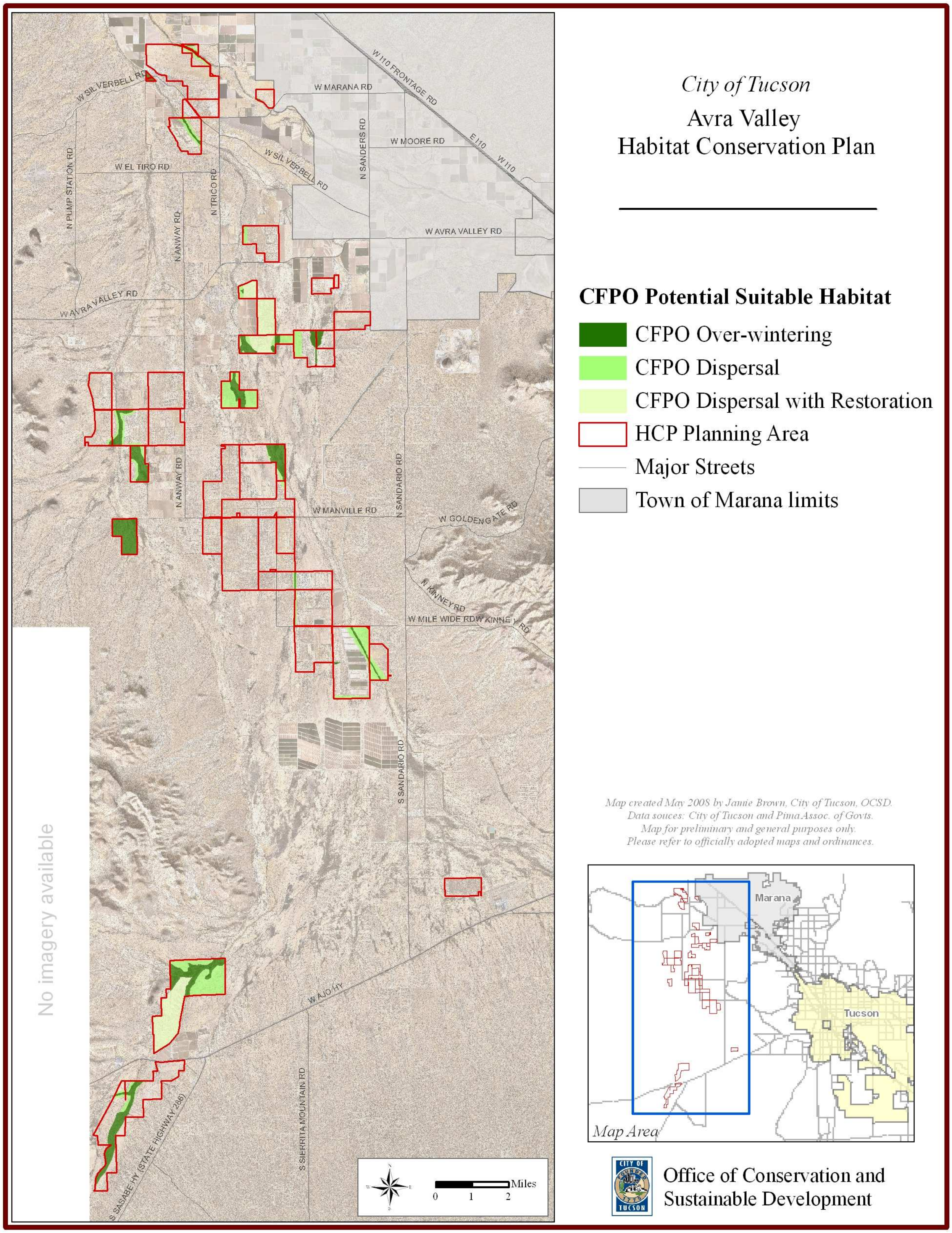

Figure 4.3-4. City of Tucson revised CFPO potential suitable habitat for the HCP Planning Area.

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

There have been no CFPO breeding or over-wintering territories documented within the Avra Valley HCP planning area. The only recorded use of the planning area has been an AGFD record of an unmated dispersing female on Duval/Pennzoil Farm parcel in the planning area in 2005. Historically, the Santa Cruz River was the site of numerous CFPO records; in recent years, there has not been any documented use of this corridor by CFPOs.

The Duval/Pennzoil and Buckelew Farm properties and portions of the CAVSARP property fall within Unit 2 of proposed Critical Habitat for CFPO. When proposing the newest Critical Habitat designations, USFWS indicated that Unit 2 consisted of a "strip of potential habitat" that provided connectivity, and the potential for movement of CFPOs, between the Tohono O'odham Nation, SNP–West, and southern Pinal County (USFWS 2002b). According to USFWS, the value of Unit 2 lies in the connectivity it provides between other units of Critical Habitat. The proposed rule recognized that much of this area, including City-owned property, have been heavily impacted by grazing, agriculture, mining, and other uses. Retired agricultural lands in Avra Valley are considered by USFWS as providing habitat connectivity and potential dispersal corridors for CFPOs (USFWS 2002b). The USFWS expects Unit 2 to be utilized for breeding only if the CFPO population was to expand (USFWS 2002b).

Parcels within the planning area also fall within RAs 1 and 2. The Duval/Pennzoil and Buckelew Farms are also located on the very northern end of the Altar Valley RA 1 (USFWS 2003c). Although this RA does contain suitable breeding habitat for CFPOs and has accounted for approximately 43 percent of documented owls, most of those records come from farther south in the Altar Valley. The Recovery Team recognized that some portions of the RAs were subject to greater threats and these areas were therefore identified as SMAs. Just east of the City parcels, the Altar Valley SMA was designated as such due to the increasing development of this area and its impact on available breeding habitat and dispersal corridors (USWFS 2003a). The two former farm holdings are not called out as either historically productive areas for CFPOs or SMAs, probably due to they're past use for agricultural production and current "recovering" status. If allowed to recover from past farming activities, the two properties represent a significant potential linkage between CFPO populations in Altar Valley and the Tohono O'odham Nation.

The CAVSARP site lies in the southern portion of RA 2, which extends from the Tohono O'odham Nation, east to City of Tucson and Town of Marana, and north to southern Pinal County, including SNP–West and Ironwood Forest National Monument (USFWS 2003c). Like Unit 2 of proposed Critical Habitat, this RA was designated primarily as potential dispersal habitat and a movement corridor for CFPO in Altar Valley (RA 1), southern Pinal County (RAs 2 and 3), and the Tortolita Fan (RA 3). Only a single confirmed CFPO record exists for this RA; however, vegetation suitable for nesting habitat does exist in some areas (USFWS 2003c).

4.3.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

Although loss of riparian habitat may have been the primary threat to CFPOs historically in Arizona, the recent loss and fragmentation of upland vegetation from large-scale residential and commercial developments has also been identified as an important threat (USFWS 2003b). Development pressure is seen as the primary threat to habitat for this species in Northwest Tucson (USFWS 2002b).

Mortality of CFPOs has resulted from a variety of natural (predation by raptors) and human causes (collisions with automobiles, glass windows, fences, and power lines). Human activities near nest sites at critical periods of the nesting cycle can impact CFPOs indirectly by causing them to abandon their nests.

CFPO habitat also can be compromised by the presence of barriers to movement, including roads and agricultural fields. There is concern that the recent drought in southern Arizona is further stressing the CFPO population through a reduction in plant growth and associated prey populations. See Table 4.3-3 for a complete list and discussion of stressors and threats to CFPO.

Table 4.3-3. Potential and Current Threats and Stressors for CFPO

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Historically, many records were from riparian areas, but current and recent records are mostly from uplands. Historical loss of breeding habitat is deemed a major factor in the decline of CFPO. This owl breeds in areas with fairly dense and diverse native vegetation, but may include some non-natives plant species as well. It requires cavities, mostly in saguaros, for nest sites, and diverse and abundant food. It also requires a home range of approximately 35 acres during the breeding season.
Dispersal	Females disperse over a long distance in search of males. Males disperse from natal area to new suitable territory, usually close to natal areas. Dispersal occurs during July to November. Loss of vegetation diversity and structure, especially tree species, results in disruption of connectivity and may impede dispersal.
Foraging	Size of foraging area is unknown, but may be related to available food supplies and therefore differs seasonally and based on the life cycle of species. Diversity of resources is important to CFPO.
Wintering	CFPOs over-winter in the Tucson area and need foraging and roosting sites. Winter food supply may be critically important. Evidence suggests that females may over-winter in dense mesquite.
Migratory stops	The CFPO apparently does not migrate, but does need suitable wintering areas and places to rest during periods of dispersal.
Fire threat	Fire may result in loss of habitat, especially nest sites.
Habitat Alteration	
Prey	Consumes diverse prey: insects, lizards, rodents, small birds. Habitat diversity provides for a variety of prey items; therefore, anything that reduces diversity is detrimental to this species.
Nest sites	Uses woodpecker holes in saguaros and (rarely) other trees as nest sites; therefore, loss of mature saguaros and/or decline in woodpecker populations would render areas potentially unsuitable.
Vegetation composition/density	The CFPO prefers high vegetation density and multiple vegetation layers. Loss of one or more layers, by fire, grazing, flood, or mechanical impacts would be detrimental to this species.
Habitat conversion	Conversion of vegetation community to annual or invasive grassland reduces plant species diversity and increases fire potential.
Escape cover	CFPO needs some protection from other raptor species, usually in the form of dense vegetation.
Fragmentation	Fragmentation of historical habitat may have led or contributed to the decline of this species. Habitat connectivity benefits this species during dispersal.
Invasive plant species	Invasion by mesquite and buffelgrass is probably bad for this species because it reduces vegetation diversity and can lead to fires.
Habitat rehabilitation potential	Anything that enhances vegetation diversity is probably beneficial to this owl. Habitat rehabilitation to enhance connectivity for dispersing owls is probably a practical approach.
Water accessibility	The CFPO is loosely associated with water, perhaps because the presence of water enhances owl escape cover and increases prey abundance.
Drought	There is concern that recent drought conditions are further stressing the cactus ferruginous CFPO population through a decrease in plant growth and associated prey populations.
Groundwater depletion	May have led to the loss of suitable habitat in the past, and may impede restoration of potential habitat in the future.
Artificial water sources	May be beneficial by enhancing prey abundance and cover.
Edge effects	May increase predation by cats, dogs, and humans.
Land use history	CFPO prefers areas of dense vegetation with saguaros and high vegetation diversity; anything that lowers density or diversity of vegetation, such as grazing, mining, land development, fire, etc., is considered detrimental to this species.
Species Characteristics	
Dispersal mechanism	Females disperse over long distances in search of males. Males disperse from natal areas to new suitable territories, usually close to natal areas. Birds fly short distances between trees. Dispersal occurs during July to November. Loss of vegetation diversity, especially trees, results in disruption of connectivity and potential dispersal corridors. Intense human activity, such as from construction and maintenance activities, may impede or influence dispersal and may make it difficult for females to locate males.
Habitat rehabilitation potential	It may be fairly easy to increase and/or improve connectivity by managing vegetation, and it may be possible to increase or improve breeding habitat by undertaking projects that maximize vegetation diversity and thereby increase the prey base.

Table 4.3-3. Potential and Current Threats and Stressors for CFPO (Continued)

Species Characteristics (continued)	
Invasive species	Effects unknown, invasive plants alter habitat structure and prey diversity adversely.
Colonization potential	The potential for this owl to colonize new area is unknown, but probably very limited due to loss of connectivity and suitable breeding habitat.
Fecundity	Although fecundity is not considered a problem, small population size limits potential for long-term survival.
Seasonal specialization	Winter availability of prey may be important.
Captive breeding/ translocation potential	Captive breeding and translocation may be a useful approach to reestablishing viable populations in some areas.
Sensitivity to disturbance	Considered sensitive to disturbance, although some individuals habituate to frequent predictable disturbance.
Interspecific Factors	
Predation	CFPO is highly susceptible to predation by raptors, and therefore does not appear to thrive in areas with high raptor concentrations or in areas with an abundance of potential raptor perches.
Competition	The extent of competition for nest cavities and prey is currently unknown.
Domestic/feral animals	Known to be preyed on by cats and may be harassed by dogs.
Edge effect	May increase susceptibility to predation, automobile collisions, and shooting.
Fire threat	Fire may cause loss of habitat, especially potential nest sites.
Off-road vehicles	ORV disturbance may be a problem if frequent, and may increase fire frequency.
Passive recreation	Not considered a problem except that bird watchers may harass this species if nesting locations are published.
Grazing	Grazing may be harmful if it reduces vegetation diversity.
Collection/hunting	Illegal collection of this species is not considered a problem. Illegal shooting, as by children with pellet guns, may be a problem in some urban locations.
Pesticides - impacts to prey	Insecticides, especially rodenticides, may reduce the prey base for this species.
Direct take/mortality	Direct take is not considered a problem.
Noise	Noise may be a problem if disturbance is frequent and/or unpredictable, particularly during the nesting cycle.
Light	The effects of light are unknown; however, high intensity lights, such as those used by the U.S. Border Patrol, may be disruptive.
Movement	Movement may be a problem if the disturbance is frequent and/or unpredictable.
Landscaping	Could be beneficial if high-density vegetation with structural diversity.
Undocumented immigrants	Undocumented immigrants may cause fires that result in habitat loss, and may cause repeated disturbance in nesting areas.
Connectivity	
Fragmentation	To facilitate dispersal, CFPO apparently needs a high degree of habitat connectivity and a high density of trees.
Barriers	Wide roads, unvegetated washes, and tall fences may act as barriers to the movement of this owl.
Wash incision	Wash incision may be beneficial if it results in the creation of new habitat for owls and prey.
Habitat patchiness	Habitat connectivity is considered crucial to this species.
Roads	Road crossings may be hazardous due to the tendency for this owl to fly low to the ground. Vegetation next to roads may be a problem if it increases the potential risk of vehicular collisions.

CURRENT MANAGEMENT RECOMMENDATIONS

The Recovery Team has recommended general guidelines for activities within RAs in order to reduce potential development impacts to CFPO. The recommendations include:

- No development activities allowed within a quarter-mile of an active nest during the breeding season (February 1 to July 31);
- Year-round restrictions on any activities within 330 feet (100 meters) of a nest site;

- Configuration of development in a manner that preserves the highest quality habitat and maintains connectivity to adjacent habitat; considerations should be given to the spatial needs of the species, breeding requirements, dispersal patterns and landscape-scale movement needs, habitat conditions, and home range requirements;
- Land acquisition and other management and conservation efforts that focus on the SMAs.

4.3.5 Potential Impacts of the City's Proposed Activities

DIRECT EFFECTS

Construction activities for Tucson Water water development projects, and supporting infrastructure and capital improvement projects (CIPs) have the potential for take of CFPOs, either through direct mortality or by harassing or harming. These covered activities would cause temporary and permanent habitat loss and fragmentation. In addition, construction activities would result in short-term noise disturbance during construction and in long-term disturbance from continued use of the project area (road or development). Short-term construction disturbances would include noise, dust, traffic, and other human activities that could result in owls leaving established territories or abandoning nest sites. Habitat impacts also could affect future use of the area by owls.

INDIRECT EFFECTS

CFPOs have rarely been documented making flights greater than 100 feet (30.5 meters), and they appear to avoid large open areas such as golf courses (USFWS 2003c). Therefore, roads and other developments can act as impediments to CFPO movement (USFWS 2003c). Wide roadways and associated clear zones also can result in owls flying directly into the path of oncoming vehicles, significantly increasing the threat of an owl being struck by a vehicle (USFWS 2003c).

Non-native cavity-nesting birds, such as starlings, tend to be found in greater numbers in disturbed areas and may compete with CFPOs for nesting cavities. An influx of starlings and other cavity nesters, associated with land development in Avra Valley, could cause a shortage of available nesting sites and reduce the suitability of nearby areas as breeding habitat.

POTENTIAL HABITAT CHANGES IN THE PLANNING AREA

Based on discussions with USFWS, for the purposes of the analysis of impacts to CFPOs in this HCP, the City of Tucson HCP CFPO Habitat Model is used to identify potential habitat within the Avra Valley planning area. However, impacts to proposed Critical Habitat also are considered when the two differ. Portions of land in the planning area contain suitable CFPO habitat.

As proposed in the City Water Plan, planned public water infrastructure and CIP projects could directly impact all suitable CFPO habitat in the Avra Valley planning area. Given the uncertainty in the Plan regarding the types and scope of projects that may be constructed within the Avra Valley planning area, the City of Tucson will assume a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, CIPs, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside of the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in fragmentation of the remaining habitat within these properties. Without knowing the final location and design of any of these facilities, the City of Tucson cannot say that any habitat in the Avra Valley planning area will not be impacted in some fashion by these covered activities.

Impacts to Proposed CFPO Critical Habitat

As proposed in the City's long-range 50-year plan, planned public water infrastructure projects could directly impact all proposed Critical Habitat in the Avra Valley planning area. Much of this area, however, is retired agricultural land and as such does not contain the constituent elements necessary to support CFPOs.

POPULATION LEVEL EFFECTS

The Avra Valley HCP planning area is subject to water development and capital improvement projects. Many individual developments will occur on adjacent parcels with no federal nexus and, consequently, will not require Section 7 ESA consultations. Within the Avra Valley planning area, the proposed covered activities could contribute to an overall loss of CFPO habitat and could lead to further fragmentation of movement corridors. It is unlikely that there would be direct take of a CFPO due to implementation of covered activities in the City HCP Avra Valley planning area. However, the potential loss of all modeled suitable habitat within the planning area could reduce the maximum number of breeding pairs in southern Arizona primarily through fragmentation of potential dispersal habitat. Habitat on lands in the Avra Valley planning area provides connectivity between breeding areas. City holdings within proposed Critical Habitat in the southern Avra Valley are located in the Black and Brawley washes floodplains, which are considered potential habitat connectivity corridors for CFPO. If water development projects on these properties occur in a manner that is not conducive to CFPO movement, the linkage between habitat to the north and south could be impaired. There is evidence, though limited, that CFPO periodically move through Avra Valley, though not necessarily on City lands.

4.4 Western Burrowing Owl (*Athene cunicularia hypugaea*)

4.4.1 Population Distribution, Taxonomy, and Status

RANGE AND DISTRIBUTION

Breeding. The western burrowing owl (*Athene cunicularia hypugaea*) has a breeding range that extends from southern Canada, east to western Minnesota and eastern Texas, and south into Baja California and central Mexico. All of Arizona is considered to be within the current breeding range for the Western burrowing owl (burrowing owl). The historical breeding range includes all or portions of 19 Western states, although Minnesota and Iowa are no longer considered as falling within the current breeding range of this owl. It has been extirpated from approximately 8 percent of its historical breeding range over the past 10 to 15 years (Klute et al. 2003).

Burrowing owls have been reported from 14 of 15 Arizona counties, with breeding confirmed in 12 counties (Brown 2001b). Currently, the two major breeding populations in Arizona are in the Tucson and Yuma areas (Brown 2001a). In Pima County, burrowing owls were reported in five USGS quadrangles between 1993 and 1999: Childs Mountain, Cat Mountain, Palo Verde Camp, Tucson SW, and West of Marana (Arizona Breeding Bird Atlas 2000). Within Tucson, most burrowing owls are concentrated at Davis-Monthan Air Force Base (AFB) and along the west branch of the Santa Cruz River (Estabrook and Mannan 1998).

Wintering. Arizona also supports wintering burrowing owls (deVos 1998). Little is known about the winter range of the subspecies because of a limited number of banding recoveries. The species regularly winters in Mexico, including Baja California, and Central America south to El Salvador, and may occasionally occur as far south as western Panama. Christmas Bird Counts in the U.S. have reported wintering owls in Arizona, California, New Mexico, Oregon, and Texas. The subspecies is also known to winter in more northern states, including Oklahoma, Kansas, and Nevada, although in low abundance (Klute et al. 2003).

Migration. The routes and timing of burrowing owl migration are not well known. The owls head north during March and April, appearing in Canada during the first week in May. Most of the owls that breed in Canada and the northern U.S. are thought to migrate south between September and October. Banded owls have been tracked from British Columbia, Washington, Oregon, and California south along the Pacific coast. Owls breeding in Alberta, Saskatchewan, Manitoba, Montana, and North Dakota have been tracked moving through Nebraska and Kansas and then settling in Texas. Banded owls from Wyoming, South Dakota, Nebraska Colorado, Kansas, and Oklahoma winter in Arkansas, Oklahoma, Texas, and Mexico. It is thought that birds from North and South Dakota migrate to Texas for the winter (Klute et al. 2003).

Seasonal movements by burrowing owls that breed or winter in Arizona are unclear. Owls from Canada and the northern U.S. may winter in southern Arizona or migrate through this area on their way to over-wintering areas in Mexico (James and Ethier 1989). Owls that breed in northern Arizona are thought to migrate in winter, while in other portions of the state, owls may be year-round residents (Brown 2001b; Phillips et al. 1964). In the Tucson area, it appears that some burrowing owls are year-round residents, while others are migratory (Estabrook and Mannan 1998). Ellis et al. (2004) concluded that year-round residents form a relatively large portion of the burrowing owls breeding in urban Tucson. Recent studies indicate that less than 40 percent of the burrowing owls present in Arizona during the summer spend the winter in Arizona (Brown and Mannan 2002). Following two years of surveys, Conway and Ellis (2004a) found that 12 to 15 percent of juveniles and 28 to 40 percent of adults (40 to 56 percent of males and 17 to 29 percent of females) living on Davis-Monthan AFB were non-migratory. Of adults occupying habitat along washes, fewer were migratory: 54 to 61 percent of adults (39 to 56 percent of males and 55 to 81 percent of females) that were found during the breeding season were also detected during the winter. The percentage of juveniles occupying wash habitat that were migratory (2.5 to 20 percent) was similar to that for Davis-Monthan AFB (Conway and Ellis 2004a). This study did not document any movement of birds between Tucson and agricultural areas near Casa Grande and Coolidge (Conway and Ellis 2004a). Ellis et al. (2004) did not find any evidence to suggest that migratory owls arrive from elsewhere and spend the winter in Tucson. Mark Ogonowski (University of Arizona) is currently conducting a study to determine the migratory status of burrowing owls in southern Arizona and to evaluate factors that may influence winter residency.

TAXONOMIC UNIQUENESS

Two subspecies of burrowing owl are currently recognized in North America by the American Ornithologists' Union, the Western burrowing owl and the Florida burrowing owl *(Athene cunicularia floridana)* (AOU 1957). *S. c. hypugaea* is the only subspecies of burrowing owl found in Arizona. The second subspecies, *S. c. floridana*, inhabits prairies of central and southern Florida. In this document, burrowing owl refers to the Western burrowing owl only.

POPULATION STATUS AND THREATS

Range-Wide Population Status and Threats. The burrowing owl has declined in abundance throughout most of its range (Haug et al. 1993). In the Western states, 54 percent of 24 jurisdictions reported decreasing burrowing owl populations; there were no reported increases (Haug et al. 1993; James and Espie 1997). Local populations of this species are especially prone to extinction (Haug et al. 1993). Only limited data exist on population sizes and trends in the U.S. Based on surveys of state biologists, James and Espie (1997) estimated that there are between 20,000 and 200,000 Western burrowing owls in the U.S.

A large proportion of the Western population of burrowing owl occurs in California (TNC 1999), which is also the state for which the owl population status and trend is best known. DeSante et al. (In Press) estimated that there are 9,266 pairs of burrowing owls in California, 95 percent of which live in the Imperial and Central valleys (Klute et al. 2003). Surveys conducted over the past 15 years show that the number of breeding groups in California has decreased by 23 to 52 percent, and the number of breeding pairs has fallen by 12 to 27 percent (DeSante et al. 1997 in Klute et al. 2003). During the 1980s and 1990s, 60 percent of the known breeding groups in the Imperial Valley disappeared (Barclay et al. 1998; DeSante et al. 1997), and surveys in the Central Valley and the San Francisco area show a decline of 52 percent in the number of breeding groups (DeSante et al. 1997). Santa Clara County has seen a loss of 60 percent of known owl locations due to development. The owl has also been extirpated in four coastal counties (DeSante et al. 1997) and is expected to be extirpated in some areas of central California in the near future (Holroyd and Wellicome 1997).

Of the 19 U.S. states in which the Western burrowing owl occurs, it is listed as Threatened or Endangered in two states, as a Species of Concern in seven states, and as vulnerable in an additional seven states. The burrowing owl has been petitioned for state listing in California, where it is currently considered a Species of Concern. The subspecies is also listed as threatened or endangered in four provinces in Canada and is listed as a federally threatened species in Mexico. Throughout its range, the owl is considered secure in only three states in the U.S. (Klute et al. 2003).

Burrowing owls have declined through much of their range because of habitat loss associated with urbanization, agricultural conversion, and rodent control programs (Johnsgard 1988). Fragmentation of existing habitat also poses a risk to owl populations. Fragmentation of habitat may result in reduced opportunities for unpaired owls to find mates, increased predator populations and vulnerability to predation, higher mortality rates among dispersing fledglings, and increased home range sizes (Klute et al. 2003; TNC 1999). When there is a shortage of suitable habitat, owls may occupy the highest-quality sites, rather than the largest and least-fragmented sites. This can lead to crowding at smaller sites, which results in increased foraging competition, reduced reproduction, and higher rates of nest abandonment (TNC 1999).

Rodent-control programs have resulted in the incidental poisoning of burrowing owls, as well as the direct destruction of their burrows (Collins 1979; Zarn 1974). Eradication efforts on black-tailed prairie dogs (*Cynomys ludovicianus*) have also resulted in the loss of burrowing owls and have also created a level of fragmentation and colony isolation that hampers recolonization of eradicated areas (Benedict et al. 1996; Desmond et al. 2000 in Klute et al. 2003). Within one to three years of being abandoned, prairie dog colonies cease to provide suitable habitat for burrowing owls (Butts 1973 in Klute et al. 2003). Survival and reproductive success can also be adversely affected if insecticides are sprayed at or near nesting colonies (James and Fox 1987).

Although burrowing owls are relatively tolerant of human activity, there are human-related impacts, such as shooting and burrow destruction, that adversely affect the owls (Haug et al. 1993; Zarn 1974). The tendency of these owls to fly low to the ground makes vehicle strikes a significant threat to the species (Klute et al. 2003). Other human activities, such as grazing, mowing, and burning, however, can improve the quality of existing habitat or create new burrowing owl habitat (Klute et al. 2003). The species is also adversely affected by the artificial enhancement (e.g., availability of artificial food sources and shelter) of native predator populations, species such as gray foxes (*Urocyon cinereoargenteus*) and coyotes, and by the introduction of non-native predators, such as red foxes (*Vulpes vulpes*), domestic cats (*Felis domesticus*), and dogs (*Canis lupus familiaris*), near burrowing owl colonies (Milsap 2002). Although there are no known significant direct threats to burrowing owls from diseases, outbreaks of sylvatic plague among prairie dog colonies can reduce the available habitat for burrowing owls (Klute et al. 2003).

Arizona Population Status and Threats. The burrowing owl is widely distributed but generally uncommon in Arizona (Brown 2001b) (Figure 4.4-1). Population data appear to be inconsistent and unreliable, with widely different estimates being made by different investigators at different times and using different techniques. James and Espie (1997) estimated the burrowing owl population in Arizona at between 100 and 1,000 birds, although this estimate was based on questionnaires rather than on a systematic survey. In 1998, an effort was undertaken to create a statewide database of known burrowing owl locations based on interviews with wildlife biologists and birders (Brown 2001b). According to these interviews, a total of 206 reported sites, representing 281 owl locations, was identified in Arizona, 164 of which were later visually surveyed (Brown and Mannan 2002). Breeding-season surveys in 2001 resulted in the detection of burrowing owls at 17.7 percent (29 locations) of the surveyed sites. Burrowing owls were found at an additional four locations outside of the established survey sites. Thirty-two of the resulting 33 occupied sites were resurveyed the following winter (Brown and Mannan 2002). Statewide, only 89 adults and 19 young were found during the breeding season, and 16 owls were located when the 164 sites were resurveyed the following winter.

The breeding range of the burrowing owl in Arizona appears to have been relatively stable in the 1990s (Arizona Breeding Bird Atlas 2000). Currently, there are two major breeding populations in Arizona, one in the Tucson area at Davis-Monthan AFB and along the floodplain of the Santa Cruz River West Branch (Estabrook and Mannan 1998) and one in the Yuma area, where high numbers of burrowing owls have been reported along the irrigation canals. Casa Grande Ruins National Monument and surrounding agricultural areas support a small population of burrowing owls (Conway and Ellis 2004b). The breeding population in Tucson typically supports 80 to 110 active burrows, with the numbers varying seasonally and annually (Estabrook and Mannan 1998). The size of the population in Yuma has not been estimated. Six nests were reported in the Phoenix Metropolitan Area in 1994, three in 1995, and five to six in 1996 (Brown 2001a). Dozens of burrowing owls have been relocated to the Tucson area from urban development sites around Phoenix. AGFD surveys for burrowing owls in 2003 and 2004 found 1,072 burrowing owls (including dispersal locations) and 58 active burrows in the Tucson basin. These surveys have been restricted primarily to Davis-Monthan AFB, portions of the main channel and west branch of the Santa Cruz River, and in and around Marana, primarily west of I-10. The number of artificial burrows installed and owls released at each site is presented in Table 4.4-1. These artificial burrows were installed between January 2004 and January 2005, and owls were released between March and September 2004.

No data are available yet regarding the number of owls that stayed and wintered at the release sites or returned after wintering elsewhere.

Table 4.4-1. Number of Artificial Burrows Installed and Number of Burrowing Owls Released at Each Artificial Burrow Site in the Tucson Area

Site Name	Number of Artificial Burrows	Numbers of Owls Released
Santa Cruz West Branch – Mission Road	4	0
Simpson Farm	32	6
Ajo Retention Basin	32	16
Cottonwood Lane	32	20
Tucson Electric Power-Irvington	64	52
Cochise AEPCO	32	0
Total	**196**	**94**

Source: Arizona Game and Fish Department, Research Branch

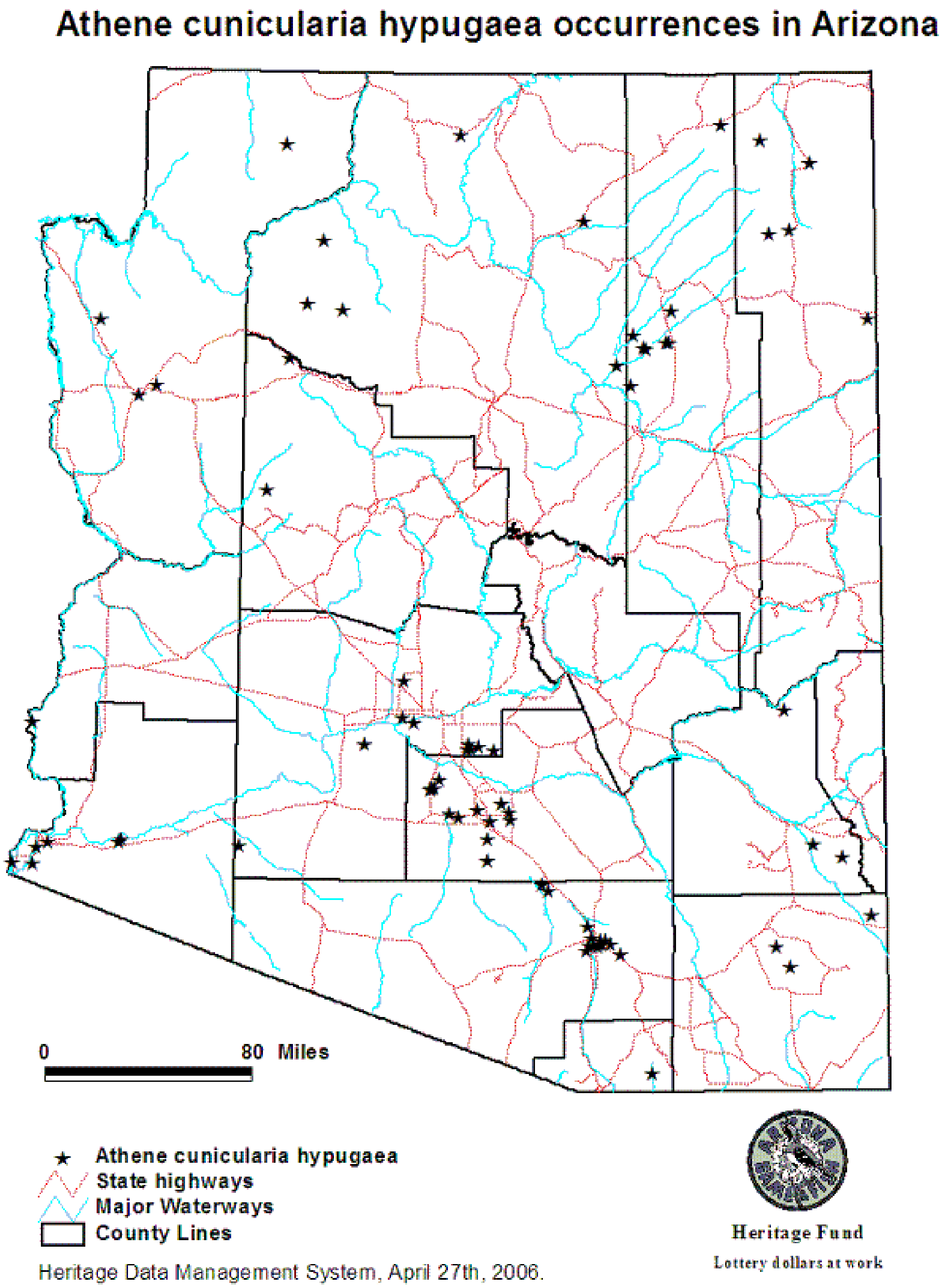

Figure 4.4-1. Distribution map of burrowing owls in Arizona based on locations reported in the HDMS. Source: AGFD.

Burrowing owls are believed to have declined in abundance in Arizona (Brown 2001b; James and Espie 1997), principally as a result of the decline in the population of Gunnison's prairie dog (*Cynomys gunnisoni*) in northern Arizona and the extirpation of black-tailed prairie dog in southeastern Arizona (Brown 2001a). Loss of habitat resulting from shrub encroachment also has contributed to declines in parts of Arizona (Brown 2001a). Grazing practices and prairie dog–control programs likely have encouraged shrub encroachment (Brown 2001a).

Brown (2001a) identified the following threats to burrowing owls in Arizona:

- Reduced habitat availability because of prairie dog– and ground squirrel–control programs;
- Bubonic plague indirectly limiting habitat availability through effects to prairie dogs and ground squirrels;
- Conversion and urban development of natural habitat and agricultural lands;
- Overgrazing of rangelands resulting in a more woody species composition and destruction of burrows;
- Reduction in prey;
- Maintenance programs of agricultural irrigation and water resources canals that destroy burrows;
- Urbanization, which increases the risk of contracting *Trichomoniasis* from doves
- Urbanization, which increases predation by domestic and/or feral animals and the potential for vehicle strike;
- Reduction in prairie dog and ground squirrel populations may increase predation on burrowing owls; and
- Agricultural pesticides.

4.4.2 Ecology

LIFE HISTORY

Breeding and Reproductive Success. The burrowing owl often lives in colonies, with many pairs nesting in close proximity. They are monogamous and generally produce one brood per season. Not all individuals capable of breeding do so every year. Breeding is initiated in early March (Terres 1980), although in California, courtship may begin as early as late December (Thomsen 1971 in Klute et al. 2003). Eggs are laid from late March to July (Terres 1980) and clutch size averages 6.5 eggs, with a range of 4 to 12 eggs (Haug et al. 1993 in Klute et al. 2003). In Tucson, nests on Davis-Monthan AFB had an average clutch size of 7.6 eggs and nests along washes averaged 6.6 eggs. Nests in agricultural areas near Casa Grande and Coolidge had mean clutch sizes of 8.8 eggs (Conway and Ellis 2004a). If a female's first clutch is lost, she may re-nest, although this has not often been documented (Haug et al. 1993).

Young are born altricial and fledge in late summer to fall (Coulombe 1971). Young owls are capable of running and foraging at four weeks and can make sustained flights by six weeks of age. Beginning when the chicks are 3 to 4 weeks of age, burrowing owl families often change burrows every 10 to 15 days until the young begin to disperse in early fall, usually moving to nearby burrows (Klute et al. 2003). Moving the chicks to satellite burrows and the use of dung, in some areas, to line burrow entrances are both thought to reduce the risk of predation (TNC 1999).

Hatching success has been reported to range from about 90 percent in Idaho to about 55 percent in California. Fledging success has ranged from 2.9 to 4.9 young per successful nest (Haug et al. 1993).

Reproductive success can differ depending on the nesting location and environment and, in particular, may be reduced by limited prey availability (CDOW 2003). Burrowing owls in New Mexico that nested in human-altered environments produced an average of 3.3 nestlings and 2.6 fledglings, while nests in natural environments resulted in an average of 1.1 nestlings and 0.7 fledglings (Bothelo and Arrowood 1996 in Klute et al. 2003).

In Tucson, Estabrook and Mannan (1998) found that 62.5 percent of 72 nests studied were successful and 16.7 percent failed. The outcome of the remaining 20.1 percent was unknown. Between these 72 nests, a total of 67 nestlings was produced, 57 of which survived past fledging. This study found that nests in open areas on Davis-Monthan AFB averaged three nestlings and 2.4 fledglings per nest, compared with 2.4 nestlings and 2.1 fledglings per nest from burrows along the main channel and West Branch of the Santa Cruz River (Estabrook and Mannan 1998).

In 2002 and 2003, Conway and Ellis (2004a) surveyed burrowing owl nests on the Davis-Monthan AFB, along several washes in Tucson, including the Santa Cruz River, and in agricultural fields near Casa Grande and Coolidge. This study found that 49.5 percent of 208 established nest sites produced one or more offspring. Success rates were highest in wash areas (67 percent), lowest on Davis-Monthan AFB (40 percent), and intermediate in agricultural areas (55 percent). Among nests in open flat areas on Davis-Monthan AFB, 41.7 percent of nests that produced young had at least one confirmed fledgling disperse. Although fledgling dispersals could not be confirmed at most of the nests along washes and in agricultural areas, the two nests at each site for which data could be collected had at least one confirmed fledgling dispersal. The minimum confirmed fledging rates at Davis-Monthan AFB, along washes, and in agricultural areas averaged 3.0, 2.2, and 3.0 young per nest, respectively (Conway and Ellis 2004a).

Nest failures on Davis-Monthan AFB were attributed to predation (31 percent), abandonment with no evidence of adult mortality (31 percent), burrow collapse (11.9 percent), vehicle-caused collapse (2.4 percent; 1 nest), and unknown causes (23.8 percent). Of the three nests that were confirmed as failing along surveyed washes, the failures were attributed, one in each case, to monsoon flooding, nest abandonment with no observed adult mortality, and unknown reasons. Nest failures in agricultural areas were found to be caused by predation (40 percent), burrow collapse due to vehicles (40 percent), and abandonment (10 percent) (Conway and Ellis 2004a).

Diet and Foraging. Burrowing owls are opportunistic feeders whose diets largely reflect prey availability (CDOW 2003). They primarily eat arthropods, small mammals, birds, amphibians, and reptiles, with seasonal shifts in the relative amounts of each type of item consumed. Owls typically consume more vertebrate prey during the winter, with arthropods, especially large insects like beetles, grasshoppers, and crickets, playing a larger role in their diet during summer (Haug et al. 1993; Johnsgard 1988). Among the mammals eaten by burrowing owls are mice, rats, ground squirrels, gophers, young prairie dogs, cottontails, and even bats. Birds are sometimes taken (Johnsgard 1988). During the summer in Arizona, predominant prey items in pellets from burrowing owls were scorpion, beetles, locusts, and small rodents (Haug et al. 1993).

Burrowing owls have been reported foraging in agricultural areas (both active and fallow fields), along roads and ditches, and in native grassland and pastures (CDOW 2003; Gervais et al. 2000). Burrowing owls, when suitable alternatives are present, seem to limit their use of cultivated areas for foraging (Haug and Oliphant 1990). Owls also seem to prefer foraging where vegetation heights are greater than 1 meter, and they avoid areas where vegetation is less than 1-meter tall (Wellicome 1994, CDOW 2003). During the breeding season, owls actively forage for invertebrates during the day and for rodents at night (CDOW 2003). When foraging for invertebrates, burrowing owls tend to remain near the nest burrow (TNC 1999).

Mortality and Predation. Little is known about the average life span or rates of mortality among burrowing owls. The longest documented life span for a burrowing owl was 8 years, 8 months (Anderson et al. 2001 in CDOW 2003). Annual survival rates, calculated based on return rates of adult banded birds to breeding sites, were estimated to be at least 29 to 58 percent (Haug et al. 1993). Annual survival rates for a non-migratory population in California were 81 percent for adult owls and 30 percent for juveniles (Thomsen 1971 in CDOW 2003). In Oklahoma, annual mortality rates have been estimated at 62 percent (Butts 1973 in Klute et al. 2003). Adult females in Saskatchewan were found to have a higher annual survival rate (62 percent) than adult males and juveniles, 48 and 45 percent, respectively (Clayton and Schmutz 1997 in CDOW 2003). Common predators of burrowing owls are badgers, bobcats, weasels, skunks, coyotes, domestic cats and dogs, snakes, and raptors such as Swainson's, ferruginous (*Buteo regalis*), Cooper's, and red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*), merlins (*Falco columbarius*), prairie (*Falco mexicanus*) and peregrine falcons (*Falco peregrinus*), great horned owls (*Bubo virginianus*), and American crows (*Corvus brachyrhynchos*) (Haug et al. 1993; Leupin and Low 2001 in Klute et al. 2003).

As part of a burrowing owl nest success study in Tucson, 17 dead adult owls were found during site surveys. On Davis-Monthan AFB, a car hit one owl, airplanes struck another three, a raptor killed one, and unknown causes were responsible for the death of two. Three dead owls were found along surveyed washes. Causes of mortality were from a vehicle strike, drowning, and unknown causes. In agricultural areas, mortality was documented from predation (two owls), collision with a vehicle (one owl), and unknown causes (one owl) (Conway and Ellis 2004a).

Site Fidelity and Juvenile Recruitment. This species exhibits moderate to high levels of site fidelity to general breeding locations, to specific nest sites (i.e., a prairie dog colony), and to particular nest burrows (Klute et al. 2003). Males are nearly three times as likely to return to a nest site than females, and individuals are more than five times more likely to return if the previous year's nest was successful than if it was not (Pezzolesi 1994 in CDOW 2003). One study found that every male owl reused the burrow it had occupied in the previous year, moving to a nearby burrow only if the original nest was destroyed (Martin 1973 in CDOW 2003). For adult owls in Colorado, the return rate to previously occupied burrows was 39 percent, with 66 percent returning to the overall breeding site (Plumpton and Lutz 1993 in CDOW 2003). In Idaho, burrows in rock outcrops were reused more frequently than those in soil mounds (48.9 percent, compared with 31.4 percent) and were more likely to be reused in consecutive breeding seasons (31 percent were occupied in at least two consecutive years, versus 13.2 percent for burrows in soil mounds). The authors suggest that the greater reuse rates for burrows in rock outcrops may be tied to the greater stability of these sites and a lower likelihood of collapse than for soil burrows (Rich 1984 in Klute et al. 2003). Burrow reoccupancy rates range from 90 percent in Colorado to 17 percent in east Wyoming (Klute et al. 2003).

In Tucson, Conway and Ellis (2004a) found that 63 percent of banded adult burrowing owls found on Davis-Monthan AFB were re-sighted the next year, and 77 percent of birds that nested along surveyed washes returned in the following year. One hundred percent of the owls identified in 2002 that returned to Tucson in 2003 returned to the same environment (Davis-Monthan AFB versus Tucson washes) they had occupied the previous year. Fifty-one percent of those birds returned to the same burrow they had used in the previous year, with burrow fidelity the same at Davis-Monthan AFB (50 percent) and along washes (51 percent) (Conway and Ellis 2004a). Return rates for males was the same for surveyed washes and Davis-Monthan AFB (80 and 81 percent, respectively), but females were much more likely to return for a second year along the washes (73 percent) than to Davis-Monthan AFB (47 percent).

Conway and Ellis (2004a) found that 17 percent of Davis-Monthan AFB juveniles and 28 percent of young from burrows along washes returned in 2003 to the site they had occupied during the previous breeding season.

HABITAT REQUIREMENTS

Breeding Habitat. Burrowing owls inhabit open areas, such as grasslands, pastures, coastal dunes, desert scrub, and the edges of agricultural fields. They also inhabit golf courses, airports, cemeteries, vacant lots, and road embankments (Haug et al. 1993). Habitat preferences include soils that are well drained and slightly sloping, a predominance of bare ground or sparse vegetation, and the presence of mammal burrows or natural or man-made cavities (Klute et al. 2003). In Arizona, burrowing owls have been documented in Great Basin, Semidesert, and Plains Grasslands; Sonoran and Mojave Desertscrub; piñon and Ponderosa pine habitats; riparian woodlands in the lower Colorado River valley; and urban, agricultural, rangeland, and vacant/barren areas (Klute et al. 2003).

Burrows are a Critical Habitat requirement for burrowing owls. Owls use burrows for nesting and also require access to alternate burrows to provide escape cover for adults and fledglings. Because they do not excavate their own burrows, burrowing owls are dependent on fossorial mammals, such as badgers (*Taxidea taxus*), ground squirrels, and prairie dogs, to create burrows. Owls have also been reported to use coyote, fox, woodchuck (*Marmota monax*), and tortoise burrows (TNC 1999). In Arizona, burrowing owls often inhabit areas supporting prairie dog (*Cynomys gunnisoni*) and round-tailed ground squirrel (*Spermophilus tereticaudus*) populations (Brown 2001b; deVos 1998). Burrowing owls on Casa Grande Ruins National Monument mostly nest in old ground squirrel burrows, followed by coyote burrows, badger burrows, and burrows of unknown origin (Conway and Ellis 2004b). These burrowing mammals usually inhabit open environments and create the burrows the owls require, as well as maintaining vegetation at a short height (deVos 1998). If the number of natural burrows is limiting, owls may instead use natural cavities, such as rock and lava cavities (Klute et al. 2003), and man-made features, including drainage tiles, culverts, and rock piles. Conway and Ellis (2004b), for example, found that owls nesting in agricultural fields surrounding Casa Grande Ruins National Monument used primarily man-made structures (39 percent, n=56). At Davis-Monthan AFB, owls typically nest in ground squirrel burrows or coyote dens (Ellis et al. 2004). Estabrook and Mannan (1998) stated that the burrowing owl distribution in Tucson is limited, at least in part, by insufficient burrow availability.

In the Tucson area, nearly all (97 percent) of the burrows used for breeding were in undeveloped areas that had been cleared of native vegetation (Estabrook and Mannan 1998). Bare ground was the predominant cover type at 87.7 percent of these active burrows. The predominant cover surrounding the remaining burrows was grass (62.5 percent), forbs (20.1 percent), shrubs (11.4 percent), and litter (6.0 percent). Overall, active burrow sites had significantly less visual obstruction by vegetation than nearby inactive burrows that appeared to be potential nest sites (Estabrook and Mannan 1998).

In a statewide survey of known burrowing owl locations, Brown and Mannan (2002) identified micro- and macro-habitat features surrounding active nesting sites. Active breeding burrows were predominantly found in agricultural areas, particularly along irrigation canals and among prairie dog towns (Tables 4.4-2 and 4.4-3).

Another important factor in nest site suitability is the density of unoccupied burrows in the area. Nest burrows in central Saskatchewan had an average of six unoccupied burrows within 30 meters (98 feet) (Haug and Oliphant 1990). In western North Dakota, there were available burrows within 7.8 meters (25.6 feet), on average, of all nest burrows studied (Stockrahm 1995 in Dechant et al. 1999). Desmond and Savidge (1996) found that there were more available burrows within 75 meters (246 feet) of successful nests than around unsuccessful nest burrows. Burrowing owl families have been documented using up to 10 satellite burrows (Dechant et al. 1999). Estabrook and Mannan (1998) found that in Tucson, areas with many large burrows supported more owls than areas with fewer and/or smaller burrows.

Table 4.4-2. Percentage of Adult Burrowing Owls and Owl Pairs Found in Various Macro-habitat Types in Arizona

Habitat Type	Percent of Adult Owls	Percent of Owl Pairs
Agricultural	50.6	50.0
Great Basin Desertscrub	12.4	19.2
Semidesert Grassland	11.2	11.5
Urban	6.7	3.8
Rural	7.9	7.7
Residential	5.6	3.8
Plains Grassland	2.2	none
Pasture	2.2	3.8
Great Basin Grassland	1.1	none

Source: Brown and Mannan (2002).

Table 4.4-3 Percentage of Adult Burrowing Owls and Owl Pairs Found in Various Microhabitat Types in Arizona

Habitat Type	Percent of Adult Owls	Percent of Owl Pairs
Irrigation canal	42.7	53.8
Prairie dog town	20.2	26.9
Creosote/Sonoran Desertscrub	11.2	11.5
Canal/levee	6.7	3.8
Pasture	3.4	none
Great Basin Desertscrub	3.4	3.8
Nestbox/agricultural	3.4	3.8
Old prairie dog town	3.4	3.8
Plowed area (culvert)	2.2	none
Plains Grassland	1.1	none
Fallow field	1.1	none

Source: Brown and Mannan (2002).

Wintering Habitat. Less is known about the habitats used by burrowing owls for wintering. Some authors have reported that agricultural fields with culverts are used more heavily in some locations (Haug et al. 1993). Owls in Louisiana have been found to winter in dunes and beaches, in or near vegetation and woody debris, and in pastures and agricultural fields (Klute et al. 2003). In Nevada and Arizona, a large percentage of owls are non-migratory and use the same sites, and even the same burrows, in winter that they use during the breeding season (Conway and Ellis 2004a; Hall et al. in review in Klute et al. 2003).

Territory Size. Burrowing owl nesting densities appear to be affected by local burrow distribution, site size, and foraging habitat quality. Reported nesting densities are highly variable, ranging from one pair per 3.1 acres to one pair per 11,366 acres (Table 4.4-4).

Table 4.4-4. Density of Burrowing Owls in Various Areas

Location	Density (acres/pair)	Reference
Lower Colorado River	3.1	Brown (1998) (in TNC 1999)
Bay Area, California	5.9	Trulio (1997)
Oklahoma[a]	10.0	Zarn (1974)
Minnesota	14.0	Grant (1965) (in Milsap and Bear 2000)
Imperial Valley, California	30.0	Rosenberg and Haley (2001)
Florida	36.0	Milsap and Bear (2000)
Imperial Valley, California	29.0–53.0	Coulombe (1971)
Oklahoma[b]	11,366.0	Zarn (1974)

[a] In prairie dog towns.
[b] More than 1 mile from a prairie dog town.

Burrowing owls maintain an exclusive area around their nest burrows (Haug et al 1993). Reported nearest-neighbor distances are more consistent than nesting densities and range from 45 feet (14 meters) to 2,950 feet (900 meters) (Table 4.4-5). Assuming a circular nesting territory, reported nearest-neighbor distances translate into nesting territories ranging from 0.04 acre to 156.8 acres (see Table 4.4-5).

During the day, burrowing owls typically remain close to their burrows, foraging farther from the nest at night. Wellicome suggests that diurnal ranges can be used to estimate nesting area requirements and nocturnal activity provides a basis for determining foraging activity (pers. comm. in Dechant et al. 1999). Owls were found to have 8.6-acre diurnal ranges in Wyoming (Thompson 1984 in CDOW 2003), 11.9 and 15.8-acre ranges in Minnesota, and nest areas between 10 and 15 acres in North Dakota (Grant 1965 in Dechant et al. 1990).

The nearest-neighbor distances are different between successful and unsuccessful nests. Green and Anthony (1989 in CDOW 2003) found that if two active nests were within 60 meters (197 feet) of each other, both nests ended up being abandoned. In nearly one-half of the nest pairs, one nest was abandoned if the pair of nests was 60 to 110 meters (197 to 361 feet) apart. If the nests were more than 110 meters (361 feet) apart, one or more of the pair were abandoned in only 14 percent of cases (Green and Anthony 1989). On the other hand, colonial nesting among owls (i.e., nesting in clusters) has been documented (Ehrlich et al. 1988 in CDOW 2003). It is unknown whether owls become less territorial as a way of reducing the risk of predation (Anderson et al. 2001) or whether this is simply a response to nest scarcity (Jones 1998). Desmond and Savidge (1996) found that in prairie dog colonies larger than 86 acres, owls nested in clusters with burrows located, on average, 410 feet (125 meters) apart. Owl nests in smaller colonies (smaller than 86 acres) were randomly distributed throughout the colony at an average distance of 345 feet (105 meters) between burrows (Desmond and Savidge 1996).

Table 4.4-5. Nearest Neighbor Distances between Burrowing Owl Nests

Location	Distance Feet (Meters)	Acres[a]	Reference
Texas	45 feet (14 meters)	0.04	Ross (1974) (in CDOW 2003)
Oakland, California	197 feet (60 meters)	0.7	Thomsen (1971)
Nebraska	344 feet (105 meters)[b]	2.1	Desmond et al. (1995)
Oregon	361 feet (110 meters)	2.3	Green and Anthony (1989)
Nebraska	410 feet (125 meters)[c]	3.0	Desmond et al. (1995)
Saskatchewan	525 feet (160 meters)	5.0	Haug (1985) (in Desmond et al. 1995)
New Mexico	545 feet (166 meters)	5.4	Martin (1973)
Imperial Valley, California	545 feet (166 meters)	5.4	Rosenberg and Haley (2001)
Florida	577 feet (176 meters)	6.0	Milsap and Bear (2000)
Nebraska	787 feet (240 meters)[d]	11.1	Desmond et al. (1995)
Idaho	2,950 feet (900 meters)	156.8	Gleason 1978 (in CDOW 2003)
Median	**525 feet (160 meters)**	**5.0**	

[a] Based on a circle with radius one-half the nearest-neighbor distance.
[b] Large prairie dog towns (≥35 ha).
[c] Small prairie dog towns (<35 ha).
[d] Badger burrows not in prairie dog towns.

Home range and foraging area may overlap between different pairs, with only the burrow being actively defended (Coulombe 1971; Johnsgard 1988). Little information is available on home range size and foraging distances for burrowing owls. Rosenberg and Haley (2001) found that burrowing owls typically foraged in areas close to burrows, with more than 80 percent of observations within 1,968 feet (600 meters) of burrows. This finding is similar to that of Haug and Oliphant (1990), who found that 95 percent of telemetry points were within this distance of a burrow. Depending on the method used to estimate home range size, average home range sizes range from 83 acres to 595 acres (Table 4.4-6). Rosenberg and Haley (2001) reported that home ranges overlapped by about 30 percent.

Table 4.4-6. Home Range Sizes (Mean ± 1 Standard Deviation) of Burrowing Owls

Location	Size (acres)	Method	Reference
Imperial Valley, California	112±45	Fixed kernel	Rosenberg and Haley (2001)
Imperial Valley, California	454±161	Adaptive kernel	Rosenberg and Haley (2001)
Imperial Valley, California	281±75	MCP[a]	Rosenberg and Haley (2001)
Saskatchewan	83±21	MCP	Sissons and Scalisi (2001)
Saskatchewan	123±34	Adaptive kernel	Sissons and Scalisi (2001)
Saskatchewan	595±170	MCP	Haug and Oliphant (1990)
Imperial Valley, California	452	MCP	Gervais et al. (2000)

[a] MCP = minimum convex polygon.

4.4.3 Baseline Conditions

AVRA VALLEY PLANNING AREA POPULATION STATUS

Recent survey results within the Avra Valley planning area suggest that some City-owned lands are more important to burrowing owls than previously thought (D. Abbate, AGFD Research Branch, pers. comm.). AGFD (Grandmaison and Urreiztieta 2006) evaluated 35 City-owned Avra Valley properties in November 2005 for burrowing owl nesting habitat potential, characterizing each property according to vegetation density, presence of concrete irrigation canals, and availability of usable burrows. The following information was recorded: the locations (i.e., the UTM coordinates) of all burrows that could potentially provide a nest site for a burrowing owl (i.e., a burrow that is at least 8 centimeters in diameter and 1 meter deep), and any sign of burrow excavating mammals (e.g., ground squirrels, badgers, coyotes, etc.). At each potential burrow, biologists recorded signs of burrowing owl activity and placed the burrow into one of the following three categories: 1) no evidence of previous use; 2) evidence of previous use, but use is not recent (e.g., old traces of feces and pellets, cobwebs or debris at tunnel entrance); 3) evidence of recent use (e.g., fresh feces, pellets, feathers, or nest decorations); and 4) owl observed. Then, AGFD personnel conducted winter and breeding season surveys for owls in suitable locations during 2006. Burrowing owls were present on nine properties, and suitable burrows were detected on 16 of them.

The winter survey conducted by AGFD in January and February 2006 detected a total of 1,836 burrows suitable for burrowing owl use based on opening dimensions and burrow depth. Seventy-one burrows exhibited sign of recent use by burrowing owls (e.g., fresh pellets, prey remains, owl feathers, and ornamentation), and 214 had evidence of past use (e.g., old pellets, whitewash). The remaining 1,551 burrows had potential to be modified for use by burrowing owls, but had no sign indicating recent or past occupancy. A total of 34 burrowing owls were detected during the winter survey. AGFD personnel revisited a total of 292 burrows during the breeding season (June 6 to June 20) that showed evidence of recent or past use, or where owls were detected during winter surveys. Of these, 117 had collapsed since the previous visit and were unsuitable for burrowing owl use. Four adult owls were detected when revisiting burrows that had supported evidence of burrowing owl use and/or where owls had been detected during the winter survey. One owl was detected at each of the following parcels: Santa Cruz, Simpson South, Cactus Avra, and Bowden farms. AGFD personnel were unable to verify active nesting as no juvenile burrowing owls were observed during breeding season surveys. However, each of three burrows associated with owl detections displayed some sign of occupancy (whitewash, fresh pellets, and feathers).

Based on 1998 interviews of wildlife biologists and birders, a total of 206 burrowing owl locations were identified statewide; 164 were later visually surveyed (Brown and Mannan 2002). In Pima County, 35 burrowing owl locations were identified based on the interview information. Of these sites, 28 were surveyed in 2001, four only partially. Six owls were found at two sites during the breeding season, and no owls were found at these locations during the winter survey (Brown and Mannan 2002). Of the two sites with documented owls, one was located inside the City limits; the second site was near the Pima–Pinal county line.

AGFD Research Branch conducted annual surveys for burrowing owls from 2003–2006. These surveys were conducted, for the most part, outside the City HCP planning area. The 2003 surveys took place in and around Marana, the 2004 surveys focused primarily on Davis-Monthan AFB and the main channel and west branch of the Santa Cruz River, the 2005 surveys were again conducted at Davis-Monthan AFB, and the 2006 surveys were conducted on City-owned Avra Valley lands as noted above. Burrow numbers are based on the number of burrows potentially suitable for use by burrowing owls based on size and depth. Owl detections are not intended to imply absolute numbers of individuals, as some individuals may have been detected at more than one burrow. The results of these surveys, relative to the City HCP planning areas, are shown in Table 4.4-7. AGFD found 172 total owls within the HCP planning area, 34 on City-owned Avra Valley parcels. Within the planning area, AGFD also found 93 active burrows, 71 on City-owned Avra Valley properties (AGFD 2006).

Table 4.4-7. Known Locations of Burrowing Owl Sightings and Active Burrows in the Tucson Basin Based on AGFD Surveys from 2003–2006

Location	Owl Records within the Specified Area	Owl Records outside but adjacent to the Specified Area	Active Burrows within the Specified Area	Active Burrows outside but adjacent to the Specified Area
Avra Valley HCP planning area	34	40	71	11
Santa Cruz River planning area (former HCP planning area)	129	137	22	20
Southlands HCP planning area	9	0	0	0
Davis-Monthan AFB	63	28[1]	5	0
All records south of Sahuarita	5	n/a	0	n/a
Total owl records inside Avra Valley HCP planning area				**34**
Total owl records outside HCP planning area				*411*
Total active burrows inside Avra Valley HCP planning area				**71**
Total active burrows outside Avra Valley HCP planning area				*47*

Source: AGFD, Research Branch.
[1] Area roughly bounded by 36th Street (north), Irvington (south), Kino Parkway (west), and Palo Verde (west).

HABITAT IN AND NEAR THE PLANNING AREA

Two different approaches have been used to delineate potential habitat for burrowing owl:

- The SDCP habitat model, and
- The City HCP burrowing owl habitat model.

SDCP Habitat Model. A habitat model for the burrowing owl was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following four primary variables:

- Vegetation;
- Slope;
- Elevation; and
- Landform.

The habitat potential of the categories of each variable was ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high-potential habitat. The four variables were combined to provide an overall habitat potential. Table 4.4-8 shows the specific categories of the variables considered to provide habitat for the burrowing owl and their habitat potential ratings.

Tucson Avra Valley HCP Burrowing Owl Habitat Model. The County did not differentiate between breeding and dispersal habitat in developing the SDCP suitable burrowing owl habitat model. However, the owl has very specific and narrow breeding habitat requirements, but can make use of almost any habitat for dispersal. By capturing both dispersal and breeding habitat in one model, wide areas may be viewed as being "suitable" for burrowing owls, even though only a small fraction of that area may be suitable for breeding. As a result, almost all the Avra Valley HCP planning area was mapped as being potential habitat under the SDCP. Since breeding habitat appears to be, by far, the more limiting factor, it was decided that the City burrowing owl habitat model would focus on breeding quality habitat, with the assumption that all other areas could be used by dispersing owls. Suitable habitat was based on evaluation by Arizona Game and Fish Department staff in which each property in the HCP planning area was qualitatively evaluated for nesting potential. Properties were characterized by the availability of usable burrows, vegetation density, and presence of concrete irrigation canals (AGFD 2006). According to Grandmaison and Urreiztieta:

> *Vegetation structure suitable for nesting burrowing owls was defined as patches of treeless areas comprised of bare ground and/or short vegetation (10 – 50 cm in height) ≥ 1 hectare in size (Uhmann et al. 2001). . .We also included low density creosote bush (Larrea tridentata) vegetation communities in this definition because burrowing owls have been observed in creosote flats at various times during the year (BISON 2006, Arizona Game and Fish Department, unpublished data). Current research evidence suggests that erosion along cement irrigation canals creates soil subsidence chambers that have the potential for burrow formation (M. Ingraldi, Arizona Game and Fish Department, personal communication 2005), and special care was taken to address these areas during our survey efforts. Therefore, we identified the presence of an irrigation canal as increasing the nesting potential for burrowing owls. Fossorial mammals (e.g., ground squirrels, badgers, coyotes) inhabit Avra Valley, and have the potential to create burrows usable by burrowing owls. Given the critical requirement of burrows for burrowing owls, we identified properties with burrows or sign of fossorial mammals observed during our initial site evaluation as having a high likelihood of burrowing owl presence (AGFD 2006).*

Table 4.4-8. Value Ratings for Characteristics of the Variables Used in the SDCP Burrowing Owl Habitat Model

Variable/Category	**Value Rating**
Vegetation	
Scrub-Grassland (Semidesert Grassland) Sacaton-Scrub (143.14)	1
Scrub-Grassland (Semidesert Grassland) Mixed Grass-Scrub (143.15)	1
Scrub-Grassland (Semidesert Grassland) Scrub-Shrub Disclimax (143.16)	1
Scrub-Grassland (Semidesert Grassland) Xeroriparian biome (143.10XR)	1
Scrub-Grassland (Semidesert Grassland) Xeroriparian Scrub-Shrub Disclimax (143.16XR)	1
Chihuahuan Desertscrub Mixed-Scrub (152.26)	1
Sonoran Desertscrub Creosote-Bursage (154.11)	1
Sonoran Desertscrub Agave-Bursage (154.15)	1
Sonoran Desertscrub Xeroriparian biome (154.10XR)	1
Sonoran Desertscrub Xeroriparian Creosote-Bursage (154.11XR)	1
Active Agriculture (999.11)	3

Abandoned Agriculture (999.12)	3
Slope	
0%–2%	3
Elevation	
195–400 meters	2
401–600 meters	2
601–800 meters	2
801–1,000 meters	2
Land Form	
Non-dissected alluvial plains	3
Dissected alluvial plains	3
Non-dissected pediments	MASK
Dissected pediments	MASK

Source: Recon (2002) *Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan*.

Burrowing owl habitat can be differentiated into breeding/wintering habitat and dispersal/migration habitat. The difference between these two types of habitats is related to how long owls will reside in the area and the types of habitat that the owl will use. Breeding/wintering habitat corresponds to the habitat descriptions provided in previous sections of this document: they consist of open, sparsely vegetated areas, with mammal burrows or other features that can be modified to provide burrows. Dispersal or migration stopovers, on the other hand, are almost unlimited in variety. Dispersing owls can be found in areas typical of breeding habitat, but they will also use areas of dense mesquite vegetation (Urreiztieta, pers comm.) or temporary man-made features such as post-holes (Abbate, pers comm.).

In Tucson, burrowing owls have been documented using dispersal stopover locations for as little as one day, and as long as two weeks. The environments in which these dispersing owls were found include: Sonoran Desertscrub, creosote, thornscrub, grassland, urban landscaping, xeroriparian, and fallow fields. The types of burrows documented as dispersal stopover locations include: coyote, badger, round-tailed ground squirrel, rock squirrel, tortoise, erosion burrows, and culverts (Urreiztieta, pers. comm.). Since burrowing owls only remain in these stopover locations for a short time period, there is no specific information available on the range of habitat use or the relative preference of migrating birds for different types of habitat. Dispersing birds are assumed to use areas similar to breeding habitat (CDOW 2003).

The Avra Valley planning area seems to offer potentially suitable breeding habitat for burrowing owls. The majority of these parcels are retired farmlands and, as such, have the sparse, short vegetation and open areas that is predominant in breeding habitat for this species. The one uncertainty regarding the potential of the Avra Valley planning area as breeding habitat is whether burrows are present, and at what densities, on the properties. Pre-existing burrows are a critical habitat element, since the owl does not excavate burrows itself; and number of burrows may be the factor most limiting to owl populations in the region. The habitat model indicates that there are 5,167 acres (2,091 ha) of potential suitable habitat for burrowing owls within the Avra Valley HCP planning area.

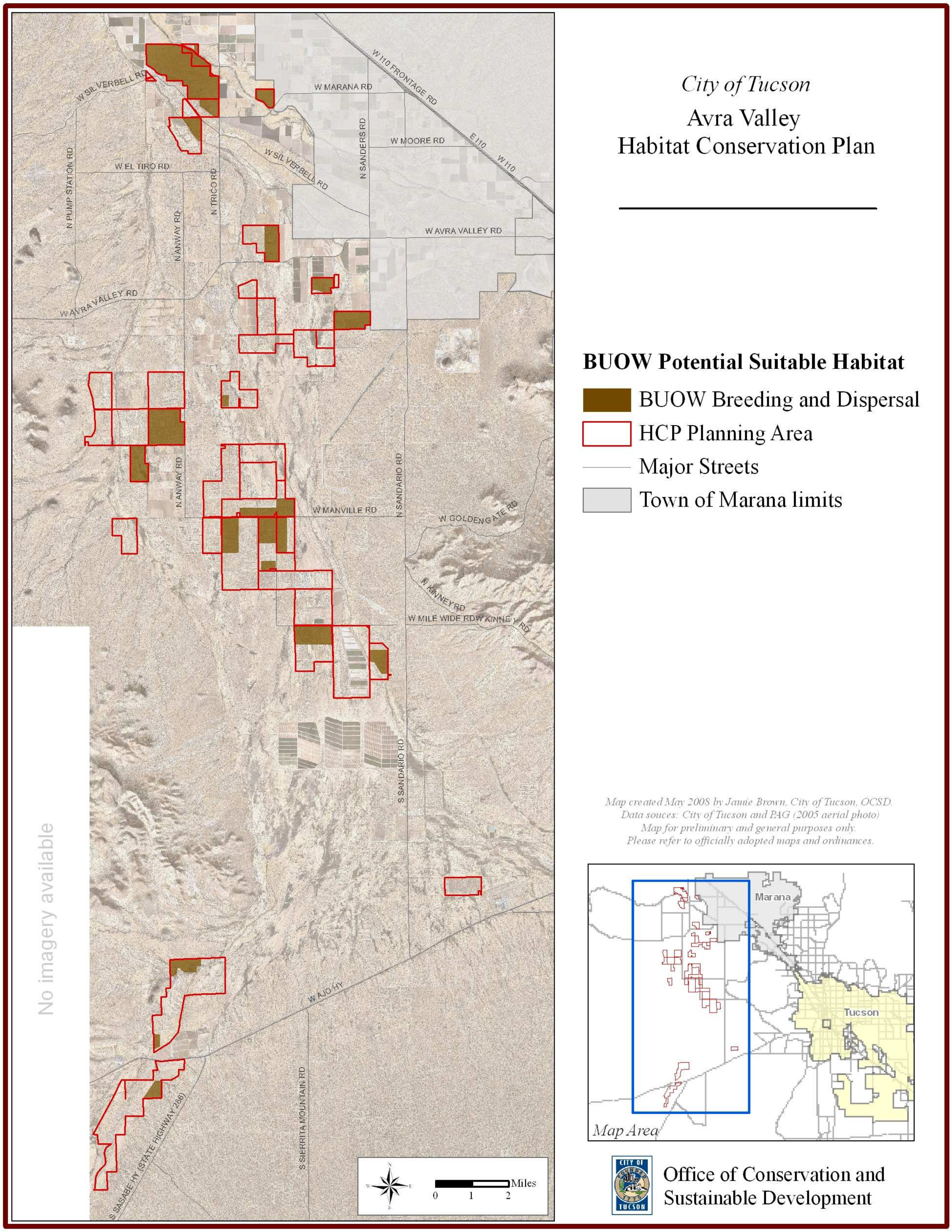

Figure 4.4-2. City of Tucson revised burrowing owl potential suitable habitat for the HCP planning area

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

Local and regional movements of burrowing owls are largely unknown. For example, it is unknown whether owls move between areas in Tucson and Phoenix. However, given the City's location and the apparent availability of suitable habitat for burrowing owls, part of the City might serve as a corridor for movement between these two populations, as well as for seasonal migrations by owls between breeding and over-wintering grounds. Habitat in the Avra Valley planning area potentially could be important to burrowing owls from Canada and the northern U.S. that may winter in or migrate through southern Arizona, but the extent of use of the planning area by wintering and migrating burrowing owls is unclear. As discussed earlier, Ellis et al. (2004) did not find any evidence to suggest that migratory owls arrive from elsewhere and spend the winter in Tucson.

4.4.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

Burrowing owls have been severely impacted by the historical loss of prairie dogs throughout their range (Johnsgard 2006). Prairie dogs were not known to have been present in Tucson, but Pima County is considered one of four counties to have comprised the historical range of black-tailed prairie dogs in Arizona (Ellis et al. 2004). Black-tailed prairie dogs were eradicated from Arizona in the 1930s (Ellis et al. 2004). Today, the primary threat to the burrowing owl is from urban development in areas that were agricultural or vacant land. Translocation of birds to new areas with artificial burrows is the standard mitigation method, but the results of this procedure have not been studied adequately.

Burrowing owls appear to be sensitive to direct disturbance from people passing near their burrows, but they are not especially sensitive to traffic noise, although they are occasionally subject to vehicle strikes. Burrowing owls are said to be susceptible to West Nile Virus, but there is little information available on susceptibility to other diseases. Overall, very little is known about their population biology and the effects of various anthropogenic factors. See Table 4.4-9 for a complete list and discussion of stressors and threats to burrowing owls.

Table 4.4-9. Potential and Current Threats and Stressors for Burrowing Owls

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Historical breeding areas were largely associated with prairie dog towns, and burrowing owls have lost habitat with the widespread eradication of prairie dogs and other burrowing rodents. Loss of breeding habitat is considered to be the most critically important threat, as areas that support burrowing owls in Arizona are largely private lands that are being developed. Limited availability of burrows will influence habitat suitability.
Dispersal	Loss of dispersal habitat is not seen as a significant threat, in part because of the wide variety of environments that the burrowing owl uses during dispersal and the relatively short time owls are thought to stay at any stopover location. Loss of areas with suitable holes for roosting is a concern.
Foraging	Average foraging area size is unknown, but it may be related to available food supply and likely differs seasonally and according to the life cycle of species. Areas with sufficient prey may be limiting within the Tucson area; however, the factors leading to a limited prey base are unknown.
Wintering	This species does winter in the Tucson area and needs foraging and roosting sites. Known wintering locations are usually the same as breeding sites, although it is possible that owls will use areas outside known breeding habitat.
Habitat Alteration	
Prey	Although this species is a diet generalist, prey availability may be limiting in areas that might otherwise be suitable for breeding or foraging habitat. Habitat diversity provides a variety of prey items, and anything that reduces the diversity of native vegetation will likely have a detrimental affect on prey availability.
Nest sites	Natural burrows may be limiting in some areas of otherwise suitable habitat; however, no information on burrow densities in the City area is currently available. Use of artificial burrows is a common tool for improving nest site availability, but the value of artificial burrows has not been well researched.

Table 4.4-9. Potential and Current Threats and Stressors for Burrowing Owls (Continued)

Stressor/Threat	Relevance to Species
Species Characteristics	
Vegetation composition/density	The burrowing owl prefers low-density vegetation surrounding burrows, but some structural diversity is necessary to support prey diversity and abundance, to serve as lookout perches near burrows, and to provide escape cover for males. Natural successional changes, such as mesquite invasion, may reduce the suitability of breeding habitat.
Fragmentation	This species appears to adapt well to a fragmented environment and is capable of finding suitable patches of habitat that are scattered across the landscape. The extent and degree of fragmentation that this species can tolerate is not known.
Invasive species	Invasion by mesquite and bufflelgrass is probably bad for this species. There have apparently been losses of burrowing owls in the Avra Valley that are contemporary with mesquite and buffelgrass invasion of inactive agricultural fields.
Habitat rehabilitation potential	The burrowing owl uses a variety of developed areas, but the widespread use of artificial burrows has not been studied over time; control of invasive plants may be beneficial.
Hydrologic changes	Drought may result in reduction of prey populations. Flooding may have adverse effects on burrows and prey.
Edge effects	Edges are not considered beneficial; this bird prefers large blocks of open habitat with few perches for larger raptors.
Sensitivity to disturbance	Owls are considered sensitive to disturbance, although some individuals habituate to frequent disturbance.
Interspecific Factors	
Predation	Owls are highly susceptible to predation by raptors and do not thrive in areas with high raptor concentrations or perches for raptors.
Disease	Burrowing owls are susceptible to West Nile Virus and known to have died from it, but the effects of West Nile Virus and other diseases on individuals and populations are unknown at present.
Competition	Burrowing owls may be subject to competition for burrows from rock squirrels and snakes.
Domestic/feral animals	This species may be preyed on by cats and harassed by dogs.
Anthropogenic Factors	
Edge effect	Large blocks of relatively barren soil or low vegetation is preferred; owls do not benefit from edges and may be harmed if edges attract raptors.
Fire threat	Fire may improve habitat by clearing vegetation; unintended fires may result in loss of habitat.
Off-road vehicles	ORVs may result in habitat loss, crushing of burrows, or impacts to prey. Such disturbance may be a problem if frequent.
Grazing	Grazing may be beneficial if it prevents growth of new vegetation.
Collection/ hunting	Collection and hunting are not considered a problem, except illegal target shooting.
Pesticides—impacts to prey	Insecticides may reduce prey base; historical use of rodenticides led to loss of prairie dogs and decline of this species; present use of rodenticides may be a serious problem for this species.
Direct take/mortality	Direct take is not considered a problem.
Noise	Noise may be a problem, depending on frequency and duration.
Movement	Movement of people may be a problem, depending on frequency, proximity, and duration.
Landscaping	Artificial landscaping could be beneficial if low-density vegetation and minimal potential raptor perches are part of the landscaping of large sites; owls are known to do well in some parks, parkways, and golf courses.
Invasives	Buffelgrass invasion may be detrimental; mesquite invasion is almost certainly a negative impact.
Automobile collisions	Automobile collisions may be a problem, but frequency is not well documented.
Connectivity	
Fragmentation	Burrowing owls live in a fragmented landscape, but prefer fairly large blocks of open country.
Wash incision	Wash incision is beneficial if it results in the creation of new habitat and harmful if burrows are lost.
Habitat patchiness	Large patches of habitat with minimal vegetation are preferred by burrowing owls.
Riparian/upland connection	The riparian/upland interface is not considered a problem, except if “restoration” projects are done in a way that causes loss of burrows and habitat.

CURRENT MANAGEMENT RECOMMENDATIONS

Burrowing owls nesting along washes in Tucson lay fewer eggs per clutch but have higher rates of nest site fidelity and nesting success than those that nest on Davis-Monthan AFB or in agricultural areas near Casa Grande and Coolidge (Conway and Ellis 2004a). Given the relatively high rates of burrow fidelity and the large number of non-migratory owls in the Tucson area, Conway and Ellis (2004a) recommend that protection of active nest burrows—particularly those along washes, which are both more productive and in shorter supply—be given high priority. Other recommendations include: protection and enhancement of existing owl populations, protection and maintenance of fossorial mammal populations, consideration to owl needs during wash maintenance activities, and education and outreach to the community.

Conway and Ellis (2004a) caution that urban environments may act as ecological traps because of higher mortality from vehicle collisions, predation by domestic cats and dogs, or other human-related impacts. They suggest that additional information is needed on the health and stability of urban owl populations before too much emphasis is placed on maintaining or enhancing urban populations. On the other hand, they note that wash-associated burrows may leave owls more vulnerable to flooding and nest collapse, while agricultural populations may face reduced reproductive success due to pesticide exposure and mortality from plowing and irrigation canal maintenance.

The USFWS produced a technical publication, *Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States* (Klute et al. 2003) that includes the following recommendations:

- Maintain continuous, large tracts of treeless, native grasslands;
- Implement protocols to minimize impacts from development and other land uses;
- Use fire, mowing, and/or grazing as necessary and appropriate to maintain suitable habitat;
- Maintain and enhance fossorial mammal populations;
- Construct artificial burrows to reduce limitations on nesting sites and provide replacement burrows for owls evicted due to development, and relocate owls as near to the site of eviction as possible, ideally within 100 meters;
- Reduce and restrict use of pesticides and use pesticides with lower toxicities, and do not spray pesticides on or near burrows during the breeding season; and
- Educate landowners and the public.

According to Trulio (1997), there are five standard approaches for maintaining breeding opportunities for burrowing owls:

- <u>Protect habitat in place</u>—This approach allows burrowing owls to remain at and, in subsequent years, to return to the site and specific burrows that they prefer. On the other hand, existing burrow sites may become increasingly isolated and subject to effects of urbanization as surrounding areas are developed.
- <u>Passively relocate owls</u>—Passive relocation allows burrowing owls to select replacement burrows when their chosen sites are lost to development. Passive relocation seems to work best when alternative sites are provided within 75 meters of the eviction site.
- <u>Create new habitat</u>—The creation of additional patches of habitat increases nesting opportunities for burrowing owls within an area. A new habitat patch created in Palo Alto, California, was successfully colonized by burrowing owls. This new habitat is located about 1 kilometer from existing occupied habitat.

- Actively relocate owls—This approach involves the capture and relocation of burrowing owls to replacement burrows outside the original home range but within the local range of the owls. The effectiveness of this approach is uncertain, but preliminary results from a project in California show that 63 percent of 27 relocated birds disappeared within 12 months after release; 26 percent of birds returned to the original nest site, reflecting the strong site fidelity of the owls. Only two out of 27 birds bred successfully, another two bred unsuccessfully, one was killed by a predator, and one owl remained on-site through two breeding seasons.
- Reintroduce owls—In this approach, owls are relocated to areas from which they were previously extirpated. None of the three large-scale reintroductions attempted in the past (in Manitoba, Minnesota, and British Columbia) have been successful.

The Grassland Ecosystem Initiative (Dechant et al. 1999) provides a number of specific management recommendations for burrowing owls. Although these recommendations focused on protecting owls and owl habitat in the Great Plains, many of the concepts remain relevant in the discussion of Avra Valley HCP burrowing owl management. These recommendations include the following items:

- Educate the public, especially private landowners, about the status of burrowing owls, the benefits of protecting habitat for the species and for burrowing mammals, and the negative effects of insecticides.
- Work to improve the image of prairie dogs (and other fossorial mammals).
- Enlist landowner's help in protecting burrows.
- Obtain easements or purchase land in prime burrowing owl habitat.
- Encourage municipal governments and agricultural representatives to reduce or restrict the use of pesticides and to use pesticides with low toxicity to non-target species.
- Preserve traditional nesting sites.
- Create a patchwork of reserves with sustainable land uses in surrounding buffer areas. Because owls forage over tall grass and nest and roost in short grass, a mosaic of habitats may be important in conserving habitat.
- Provide fresh horse or cow manure near nesting areas. Burrowing owls use shredded manure to line their nests, possibly to mask odors as a predator-avoidance strategy.
- Install artificial burrows where natural burrows are scarce.
- Provide supplemental food during the nestling stage as a short-term solution if food appears to be limiting; take care not to overfeed, as excessive food caching may attract predators.
- Provide observation perches where vegetation is tall.
- Allow heavy grazing on saline, gravelly, stony, or sandy areas; allow moderate to intense grazing on good soils that otherwise would support tall vegetation.
- Do not spray pesticides within 400 to 600 meters (1,312 to 1,969 feet) of burrowing owl nests during the breeding season.
- If lethal control of burrowing mammals is necessary, restrict the timing of control activities to avoid the period when burrowing owls choose nest sites or are nesting.
- Protect colonies and increase populations of burrowing mammals.
- Maintain abandoned prairie dog colonies at an early successional stage, with short vegetation (<8 centimeters [3.2 inches] tall).

- Preserve, restore, or enhance prey habitat (such as road ROWs, haylands, and uncultivated areas of dense, tall vegetation) within a 0.6-mile radius of nesting areas.

4.4.5 Potential Impacts of the City's Proposed Activities

DIRECT EFFECTS

Construction activities for water supply projects and associated capital improvement infrastructure have the potential to directly kill or injure owls by filling in or collapsing burrows. The number of owls potentially impacted in this manner is unclear. An estimated footprint of approximately 7,300 acres in Avra Valley may be needed to expand public water infrastructure (e.g., recharge basins, evaporation ponds, treatment plants, etc.), and these developments have the potential to disturb existing burrowing owl habitat depending on their location and configuration. Given the friable nature of the soils in Avra Valley, areas of high burrow density should be avoided by heavy machinery that has the potential to collapse burrows.

Additionally, the City is currently implementing buffelgrass management efforts in Avra Valley. Possible direct effects that could result from this include running over burrows with tractors and directly spraying owls. These concerns were addressed and mitigated as part of buffelgrass management strategies prepared by the City. As part of buffelgrass management efforts, which has included glyphosate spraying, the City contracted Courtney Conway and Victoria Garcia of the University of Arizona to study the effects of glyphosate applications on burrowing owls. According to their final report:

> *Treating areas for buffelgrass does not appear to negatively impact burrowing owls, but our power to detect differences was limited due to the few number of burrowing owls found to be occupying the treatment areas (and Avra Valley in general) in 2007. Treating the areas surrounding one burrowing owl nest with herbicide did not cause abandonment and burrowing owls in the treatment and control areas did not differ in apparent nesting success, number of offspring per successful nest, and adult morphological measurements. We did detect a possible difference in body mass of young juveniles between the treatment and control areas. However, because only one nest in the treatment area produced juveniles, we have no way of determining whether is possible difference is real and if so, whether it is associated with the treatments or with some other factor (2007)*

INDIRECT EFFECTS

The burrowing owl population could be adversely affected through indirect mechanisms facilitated by or resulting from land development. Potential indirect adverse effects to burrowing owls from land development include increased disturbance from maintenance activities associated with water infrastructure projects. Vehicle strikes also can cause owl mortality.

There are also potential indirect effects that could result from the buffelgrass management program discussed above. The potential indirect threat of bioaccumulation has been addressed and supporting research indicates that this should not cause significant adverse effects—with the use of products that include glyphosate—for the burrowing owl in the Avra Valley planning area. Buffelgrass management is expected to decrease cover in the short-term, which could lead to changes in the prey base available for the owl.

Potential Habitat Change

Impacts to Potential Burrowing Owl Habitat in the Avra Valley Planning Area

As proposed in the City Water Plan, planned public water infrastructure projects could directly impact all suitable burrowing owl habitat in the Avra Valley planning area. Given the uncertainty in the City Water Plan regarding the types and scope of projects that may be constructed within the Avra Valley planning area, we are assuming a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside of the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in additional habitat loss or degradation within these properties. Without knowing the final location and design of any of these facilities, we cannot say that any habitat within the Avra Valley planning area will not be impacted in some fashion by these covered activities.

POPULATION-LEVEL EFFECTS

Water supply development could result in a direct reduction in the local burrowing owl population in the Tucson planning area, although the extent of that reduction is unclear. Burrowing owl use of other areas (i.e., agricultural properties within the Avra Valley planning area) is poorly understood at present, so it unclear what might be the effect of habitat loss in this area. The level of use of habitats in the Avra Valley planning area by wintering and migratory owls is currently unclear, although initial survey results indicate that a number of owls winter at potential breeding sites in the planning area. For those lands within the Avra Valley planning area that are currently being used as nesting/wintering habitat by burrowing owls from within and outside Arizona, land development could contribute to reductions in the number of owls nesting/wintering or using City lands for migratory stopovers, and increase mortality from vehicle collisions, predation, and exposure to disease. While it is conceivable that these types of impacts would result from future land development, the number of owls affected and the impact on local and regional populations of burrowing owls is unclear, and would depend significantly on where exactly within the planning area these water developments take place.

4.5 Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*)

4.5.1 Population Distribution, Taxonomy, and Status

RANGE AND DISTRIBUTION

The range of the Western shovel-nosed snake (*Chionactis occipitalis*) encompasses most of the Mohave and Sonoran desert regions of the Southwestern U.S. and a small portion of contiguous Mexico. This species' range extends from below sea level to about 4,700 feet (1,430 meters) (Stebbins 1985). In Arizona, it is associated with valley floors below 2,000 feet (610 meters) (Lowe 1964). Rosen (2003b) described shovel-nosed snakes as being abundant in the great dunes of the Gran Desierto, Lower Colorado River Valley, and Mohave Desert.

Four subspecies of shovel-nosed snake have been described. The historical range of the Tucson shovel-nosed snake (*C. o. klauberi*) is believed to have extended in a narrow band from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of the City (Recon 2002). As currently mapped, this range encompasses the margin of the Arizona Upland Subdivision of the Sonoran Desert biome, which includes portions of Scottsdale, Florence, Casa Grande, Avra Valley, and

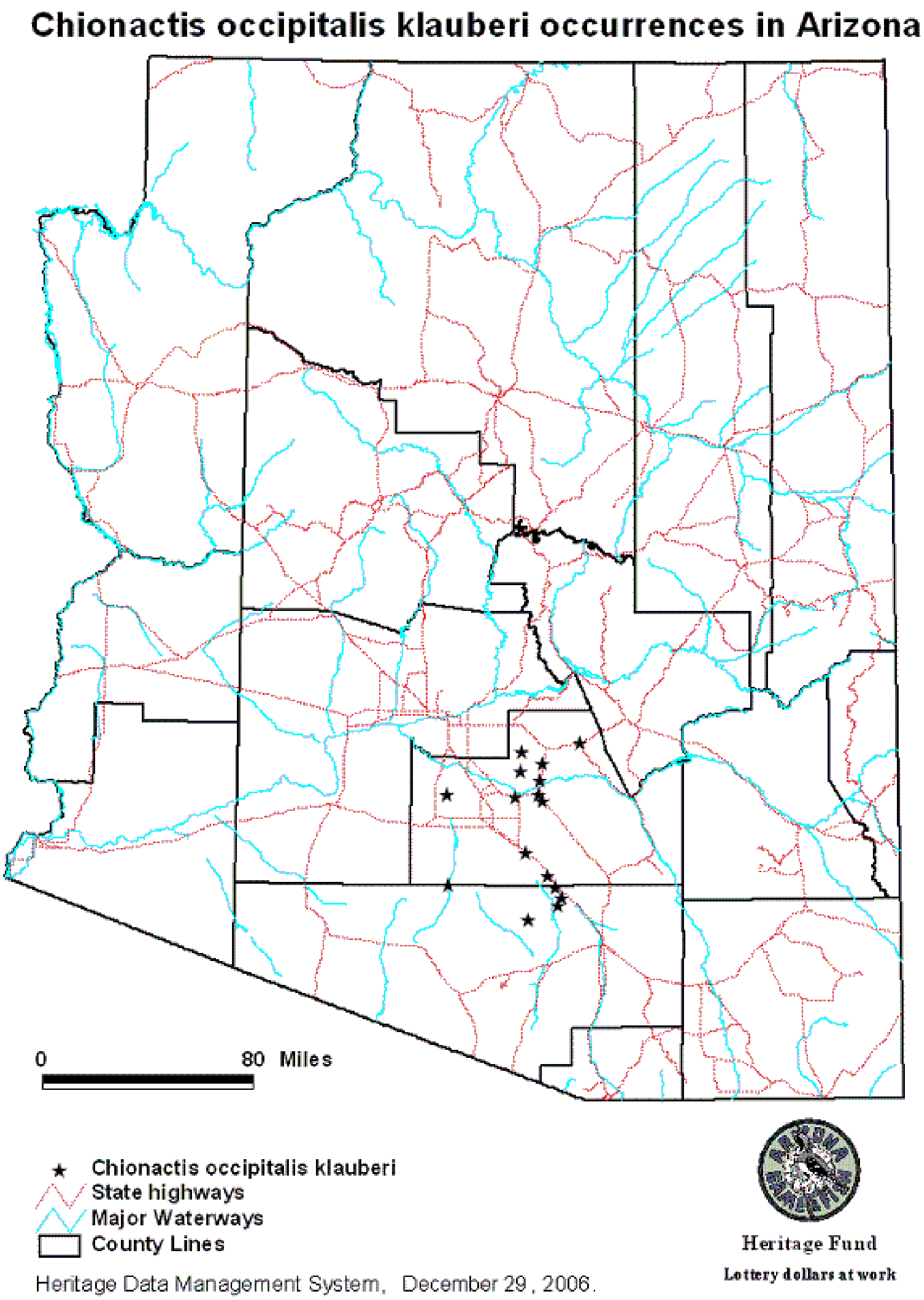

Figure 4.5-1. Distribution map of Tucson shovel-nosed snake in Arizona based on locations reported in the HDMS. Source: AGFD.

the City (Rosen 2003b). Snakes with characteristics considered intermediate between Colorado Desert shovel-nosed snake (*C. o. annulata*) and Tucson shovel-nosed snake may occupy the northeastern edge of the Tohono O'odham Nation, Sonoran Desert National Monument near Mobile, and the vicinity of Ajo (Rosen 2003b). Figure 4.5-1 shows the distribution of Tucson shovel-nosed snake in Arizona based on locations reported in the Heritage Data Management System (AGFD).

TAXONOMIC DISTINCTNESS

Three of the four subspecies of the Western shovel-nosed snake occur in Arizona: Colorado Desert shovel-nosed snake (*C. o. annulata*), Tucson shovel-nosed snake, and Mojave shovel-nosed snake (*C. o. occipitalis*) (AHA 2005). The Colorado Desert shovel-nosed snake and Tucson shovel-nosed snake populations intergrade over much of their ranges (CBD 2004). The portion of the Colorado Desert shovel-nosed snake range that does not overlap the range of the Tucson shovel-nosed snake covers most of La Paz and Yuma counties. The intergrade range for these two subspecies has been defined broadly as extending from eastern Yuma and La Paz counties east to central Maricopa and Pima counties, and covering most of Yavapai County (AZ PARC 2005). Klauber (1951 in CBD 2004) described a narrower intergrade zone from Gila Bend east to Casa Grande, and Ajo north to Aguila. The Arizona population of the Mojave shovel-nosed snake has a range that primarily covers southern Mohave County and, although it is adjacent to the Colorado Desert–Tucson shovel-nosed snake intergrade zone, is geographically disjunct from the unique range of the Tucson shovel-nosed snake (AZ PARC 2005).

The taxonomy of the Western shovel-nosed snake is not well understood and has not been recently addressed in the published literature. The current taxonomy of the three Arizona subspecies is based on differences in color patterns and, as a result, may not reflect evolutionary divergence among the species (Mahrdt et al. 2001 in NatureServe 2005). The Colorado Desert shovel-nosed snake is differentiated by having black bands that are narrower, less densely spaced, and more cleanly distributed than the Tucson shovel-nosed snake (AZ PARC 2005). In addition, the Tucson shovel-nosed snake has black, brown, or purplish secondary bands, i.e., bands that do not contact the ventral surface, as opposed to the Colorado Desert subspecies, which has red secondary bands (CBD 2004). The Mojave shovel-nosed snake typically lacks the narrow orange-red saddles that occur between the black bands in the Colorado Desert and Tucson shovel-nosed snake subspecies. Although there is some question regarding the subspecific taxonomy of the Western shovel-nosed snake, Rosen (2003b) indicated that there is evidence of significant local adaptation that does not appear to be subject to full genetic mixing among the subspecies. He supports the current taxonomic classification of the snake and suggests that even smaller valid taxonomic units that may be "evolutionary significant units" could exist (Rosen 2003b).

POPULATION STATUS AND THREATS

A petition was filed in December 2004, requesting that the Tucson shovel-nosed snake be considered for listing under the ESA (CBD 2004). The listing petition includes both the intergrade and non-intergrade portions of the Tucson shovel-nosed snake populations (CBD 2004).

Rosen (2003a) speculates that populations in the area of Scottsdale, Florence, and Casa Grande have been severely impacted or extirpated. Systematic surveys have not been conducted in these areas and, therefore, the status of the species across its entire range is imperfectly known. Northern Avra Valley is one of the few areas that have been extensively surveyed. As late as the mid-1970s, surveyors were observing Tucson shovel-nosed snake as many as 2 to 3 times per night (CBD 2004). Rosen (2003b) surveyed for the subspecies in and around Marana in 2003. He failed to detect any shovel-nosed snakes and, given the absence of records since 1979, concluded that the Tucson shovel-nosed snake population has severely declined in the Avra Valley since the 1960s and 1970s and may now be extirpated from the area. In 2004, however, Rosen (2004) reported that a Tucson shovel-nosed snake was observed near

Picacho. Western shovel-nosed snakes have also been recorded in the Sonoran Desert National Monument near Mobile. However, the subspecific identity of these individuals has not been verified. The specimens appear to range in character from similar to Colorado Desert shovel-nosed snakes to “somewhat to strongly resembling” Tucson shovel-nosed snakes (Rosen 2003b).

The primary threat to the Tucson shovel-nosed snake, and likely cause of the subspecies’ presumed decline, is the loss of habitat through agricultural and urban development (CBD 2004). Grading and farming of former habitat alters soil conditions and removes native vegetation, thereby eliminating essential habitat components for this species. It is unknown whether natural recovery or restoration of degraded soils to a condition that is suitable for re-colonization by Tucson shovel-nosed snakes is possible (CBD 2004).

Identified threats to the subspecies include:

- Agricultural development;
- Urban development;
- New road construction;
- Increased traffic on new and existing roads;
- ORV activity; and
- Possibly scientific and commercial collection of the subspecies.

Another potential factor in the decline of Tucson shovel-nosed snake populations may be competition from the morphologically, ecologically, and behaviorally similar banded sand snake (*Chilomeniscus cintus*) (Rosen 2003b). The banded sand snake is thought to prefer a “richer” or less arid desert environment than the shovel-nosed snake. It is assumed to have historically occupied areas adjacent to shovel-nosed snake habitat, on bajadas along the Santa Cruz River east of the Tucson Mountains and along a sandy ridge that separates the Santa Cruz River floodplain from the combined floodplains of the Brawley, Los Robles, and Blanco washes (Rosen 2003b). Drawing an analogy from the relationship between desert horned lizards and regal horned lizards, Rosen suggests (2003b) that the banded sand snake population and distribution may be expanding at the expense of shovel-nosed snakes. The banded sand snake was not recorded on the floor of Avra Valley until 1983, after which it appears to have increased in abundance. This time frame coincides with the marked decline in shovel-nosed snakes, from reasonably abundant during the 1970s to undocumented after 1979. Whether the sand snake is contributing to the decline of the shovel-nosed snake or simply invading altered habitat following extirpation of the shovel-nosed snake is uncertain.

4.5.2 Ecology

LIFE HISTORY

The shovel-nosed snake is adapted to moving quickly through loose sand and loamy soils. This movement has been described as sand swimming (Stebbins 1985; Rosen 2003b). This small (250 to 425 millimeters) coral snake mimic uses venom to subdue its prey, which includes insects, scorpions, spiders and centipedes (Stebbins 1985; Rosen 2003b). The shovel-nosed snake feeds frequently and, as a result, is thought to actively forage from at least April through October (Rosen et al. 1996 in CBD 2004).

The shovel-nosed snake is thought to breed in May and June. Only a quarter of females surveyed during the breeding season were found to be reproductively active, indicating that all females do not breed each year (Goldberg 1997 in CBD 2004). The species is oviparous and has a clutch of 2 to 4 eggs in the summer (Stebbins 1985).

Western shovel-nosed snakes are primarily nocturnal (Stebbins 1985), although on cool days they may also be active in the late and early evening (Warren 1953 in Recon 2002). Daily activity seems to peak from dusk until just after dark, roughly from 19:00 to 21:00 hours (Rosen et al. 1996 in CBD 2004). Shovel-nosed snakes spend the daytime under the surface of the soil beneath a creosote bush or under objects, such as boards (CBD 2004). Rosen (2003b) researched the seasonal activity cycle of the Tucson shovel-nosed snake as part of a recent survey effort. He discovered that activity peaks during May and decreases rapidly through late June. There is residual activity in early July and almost no observed activity after that. Shovel-nosed snakes also appear to be more active after warm summer or hot spring days and on days with higher relative humidity (Rosen et al. 1996 in CBD 2004). During the winter, the snake will often hibernate in small, enclosed burrows beneath but near the surface of the soil (CBD 2004).

HABITAT REQUIREMENTS

The Western shovel-nosed snake is known from the Lower Sonoran life zone, primarily on valley bottoms with sand dunes or soft sandy loams. More detailed habitat preferences of the species have not been systematically examined (CBD 2004). Rosen (2003b) suggests that populations in Avra Valley centered on the valley floor, with only fringes of the distribution extending into adjacent bajadas. He also notes that the species appears to prefer productive creosote-mesquite floodplains, but also may occur in areas of open upland creosote (Rosen 2003b). The species prefers soils containing small amounts of gravel (Rosen 2003a).

4.5.3 Baseline Conditions

CITY POPULATION STATUS

The last known record of the Tucson shovel-nosed snake in the vicinity of the City was at Sanders Road and Avra Valley Road in 1979. It is unknown whether the species persists within the City HCP planning area. It was not observed during species-specific surveys conducted in and around Marana in 2003. However, these surveys were initiated during the latter half of the seasonal activity cycle when the snake was much less active (Rosen 2003b). The previously mentioned record of a Tucson shovel-nosed snake observed near Picacho in 2004 demonstrates that the species is not regionally extinct, and may still inhabit the Avra Valley (Rosen 2004).

Previous survey work concentrated along Avra Valley Road and Mile Wide Road. Although many Tucson shovel-nosed snakes were observed in the 1960s and early 1970s, none have ever been found west of Pump Station Road or along the portion of Avra Valley Road that is within 3 miles of I-10. In addition, no shovel-nosed snakes have been observed along Mile Wide Road. This recorded distribution led Rosen (2003b) to conclude that most of the original population occurred north of Mile Wide Road, and likely north of Manville Road. There are few records from the area where Avra Valley Road crosses Brawley Wash, specifically between Sanders Road and Trico Road. This dearth of records is thought to be due to the presence of adobe-like soils near Brawley Wash that are too hard to be suitable for shovel-nosed snakes (Rosen 2003b).

HABITAT IN AND NEAR THE PLANNING AREA

Two different models have been developed to delineate potential habitat for the Tucson shovel-nosed snakes:

- The SDCP habitat model; and
- A habitat model developed by Dr. Phil Rosen for the Town of Marana HCP.

SDCP Habitat Model. A habitat model for the Tucson shovel-nosed snake was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following four primary variables:

- Vegetation;
- Slope;
- Elevation; and
- Landform.

The habitat potential of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high-potential habitat. The four variables were combined to provide an overall habitat potential. Table 4.5-1 shows the specific categories of the variables considered to provide habitat for the Tucson shovel-nosed snake and their habitat potential ratings.

City Habitat Model. When developing the Tucson shovel-nosed snake habitat model for the Town of Marana HCP, Dr. Rosen concluded that elevation and soil taxonomy and condition provide the best overall predictors of potential habitat for this species. Elevations greater than 2,300 feet (700 meters) were eliminated because existing records do not include observations of the species above that elevational limit. Active agricultural lands and developed areas were eliminated as potential habitat because soils in these areas are no longer suitable for use by this species.

This model was considered to be as accurate and appropriate for identifying habitat within the Avra Valley HCP planning area as it had been for use in the Town of Marana HCP planning area, with one exception. Although agriculture has been prevalent in both Marana and the City's Avra Valley planning area for decades, and continues to be practiced in Marana, all of the City's lands within the Avra Valley planning area were retired from farming between 20 and 30 years ago. Although farming dramatically reduces the suitability of the land for this species, as these lands recover from cultivation, however, it is plausible that they may return to being suitable habitat. The City's former agricultural lands therefore cannot be ruled out as future snake habitat as long as they have appropriate soil types and occur within the elevational range of the species. Due to the potential recovery of snake habitat in these areas, these former farmlands are considered as possible restoration areas for the species in the City Tucson shovel-nosed snake habitat model. It must be noted, however, that it is currently unknown how long these lands must remain fallow for natural processes to restore them to suitable Tucson shovel-nosed snake habitat.

The combination of soil type, elevation range, and past land use (cultivated or not cultivated) results in a possible 12 habitat suitability classes for this species within the planning area. In order to simplify conservation planning for this species, these 12 classes were aggregated into low-, medium-, and high-potential habitat based on the input of Dr. Rosen. According to Dr. Rosen, soil type takes precedence over elevation and any properties with good soils should be "high" potential in a 3-tiered system. Marginal soils, regardless of elevational suitability, do not provide "high" potential habitat. The overall suitability for each soil type and elevation combination is presented in Table 4.5-2, for uncultivated land, and Table 4.5-3, for previously farmed properties. The output of the habitat suitability model for the Tucson shovel-nosed snake is shown in Figure 4.5-2 and Table 4.5-4. Lands classified as either high or moderate habitat potential were combined to determine the amount of suitable habitat within the planning area, which totaled 2,450 acres (991 ha).

Table 4.5-1. Value Ratings for Characteristics of the Variables Used in the SDCP Tucson Shovel-Nosed Snake Habitat Model

Variable/Category	Value Rating
Vegetation	
Scrub-Grassland (Semidesert Grassland) Scrub-Shrub Disclimax (143.16)	1
Scrub-Grassland (Semidesert Grassland) Xero-riparian Scrub-Shrub Disclimax (143.16XR)	1
Sonoran Desertscrub Creosote-Bursage (154.11)	3
Sonoran Desertscrub Paloverde-Mixed Cacti (154.12)	1
Sonoran Desertscrub Agave-Bursage (154.15)	3
Sonoran Desertscrub Saltbush (154.17)	2
Sonoran Desertscrub Xeroriparian biome (154.10XR)	3
Sonoran Desertscrub Xeroriparian Creosote-Bursage (154.11XR)	3
Sonoran Desertscrub Xeroriparian Paloverde-Mixed Cacti (154.12XR)	3
Slope	
0%–2%	1
2%–5%	1
5% and above	Mask (should explain what this means)
Elevation	
401–600 meters	3
601–800 meters	1
801 meters and above	Mask
Land Form	
Drainageways	3
Streambeds	3
Floodplains	3
Terraces	3
Non-dissected alluvial plains	3
Dissected alluvial plains	3

Table 4.5-2. Habitat Suitability Classes for Non-cultivated Lands*

Soil Type Suitability Rating	Elevation Suitability Rating	Overall Habitat Potential Rating
3	3	High
3	2	High
3	1	High
2	3	High
2	2	Moderate
2	1	Moderate
1	3	Moderate
1	2	Moderate
1	1	Low

*Overall ratings recommended by Dr. Phil Rosen.

Table 4.5-3. Habitat Suitability Classes for Previously-cultivated Lands*

Soil Type Suitability Rating	Elevation Suitability Rating	Overall Habitat Potential Rating
3	3	High Restoration Potential
3	2	High Restoration Potential
3	1	High Restoration Potential
2	3	High Restoration Potential
2	2	High Restoration Potential
2	1	Poor Restoration Potential
1	3	Poor Restoration Potential
1	2	Poor Restoration Potential
1	1	Poor Restoration Potential

*Overall ratings recommended by Dr. Phil Rosen.

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

The planning area and vicinity represent a small and likely inconsequential portion of the range of this widely distributed species (i.e., most of the Mohave and Sonoran deserts). The range of the subspecies under consideration here extends from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of a portion of the Avra Valley planning area. It is possible that the Tucson shovel-nosed snake genotype might only be available for long-term conservation in the area of Mobile, Arizona (Rosen 2003b).

4.5.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

The primary threat to the Tucson shovel-nosed snake, and likely cause of its presumed decline, is the loss of habitat through agricultural and urban development (CBD 2004). Grading and farming of former habitat alters soil conditions and removes native vegetation, thereby eliminating essential habitat

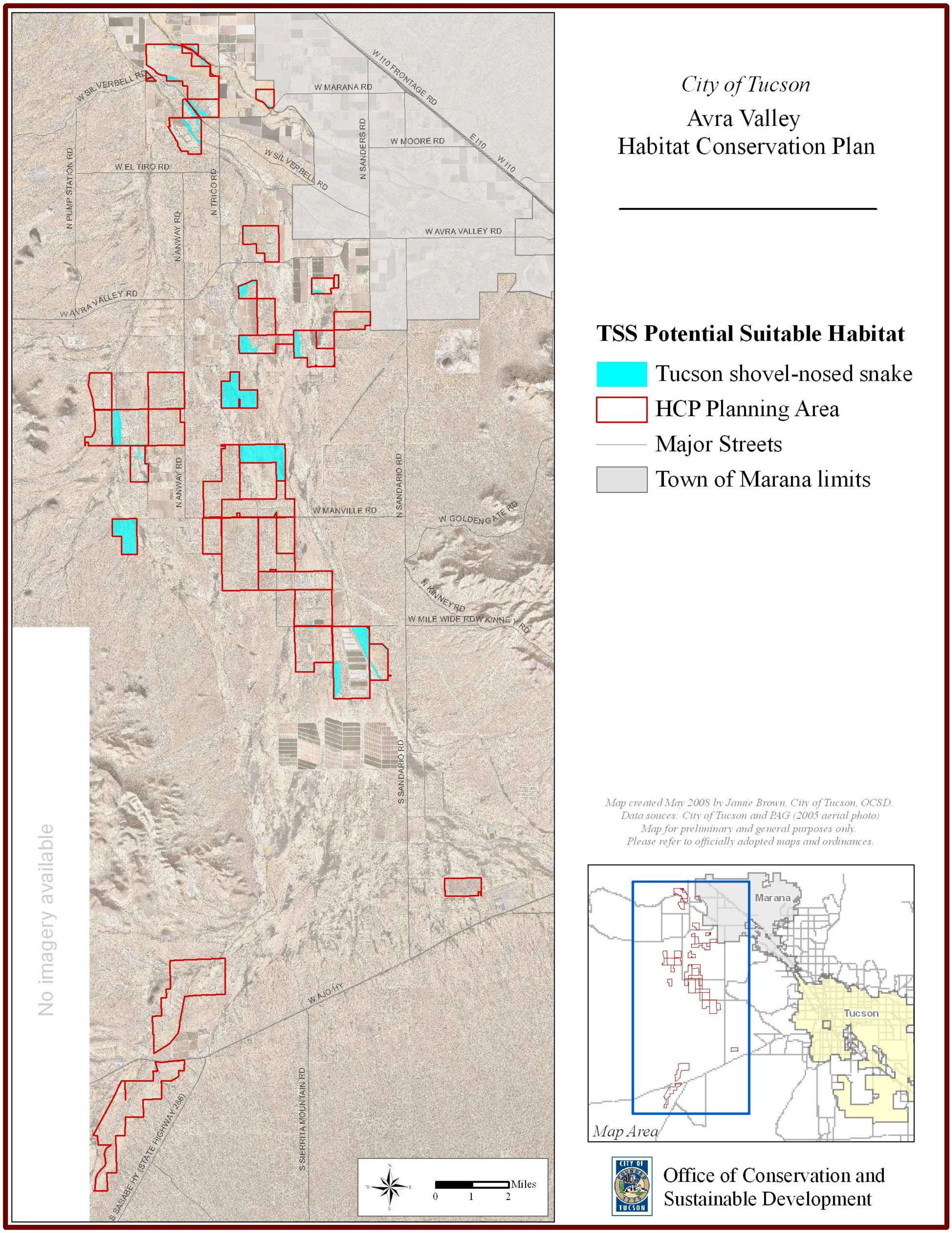

Figure 4.5-2. City of Tucson revised shovel-nosed snake potential suitable habitat for the HCP Planning Area

components for this species. It is unknown whether natural recovery or restoration of degraded soils to a condition that is suitable for re-colonization by Tucson shovel-nosed snakes is possible (CBD 2004). Another potential factor in the decline of Tucson shovel-nosed snake populations may be competition from the morphologically, ecologically, and behaviorally similar banded sand snake (Rosen 2003b).

Essentially nothing is known about the demographics or population dynamics of this snake. Habitat requirements also are not well known, except that this snake requires undisturbed desert vegetation communities. Vehicle collisions are a serious problem, and were almost certainly more of a problem historically. See Table 4.5-5 for a complete list and discussion of stressors and threats to Tucson shovel-nosed snake.

Table 4.5-5. Potential and Current Threats and Stressors for Tucson Shovel-Nosed Snake

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Loss of habitat to agricultural and urban development is regarded as the most serious historical threat to this species. Loss continues today, to a lesser degree, as urban development occurs in previously undeveloped land that may still support this species.
Dispersal	Dispersal is limited for a small snake. The ability to disperse has been compromised by roads, developed areas, irrigation and drainage ditches, and areas with impacted soils.
Foraging	Size of foraging area is unknown, but is almost certainly related to available food supply and available suitable soils; diversity of resources is important.
Habitat preferences	This snake uses rodent burrows and litter (e.g., boards) as shelter for unknown periods of time; rodents have largely been eradicated as a result of agricultural and urban development from areas where this snake once lived.
Habitat Alteration	
Prey	This snake consumes a diversity of invertebrate prey; loss or reduction in populations of suitable prey species through habitat loss and invasive competitors is probably a significant threat, but further research is needed.
Vegetation composition/density	The loss of native desert vegetation by conversion to agricultural fields was an important cause of population loss.
Fragmentation	Fragmentation of historical habitat may have led or contributed to endangerment of this species; remaining potentially suitable areas are isolated by barriers.
Invasive plant species	Invasion by mesquite, buffelgrass, and red brome reduces vegetation diversity and can lead to fires, changes in soil characteristics, and reduced prey availability.
Invasive animal species	Effects are unknown, but concern has been expressed about invasive non-native insects, such as cockroaches, that out-compete native food animals.
Habitat rehabilitation potential	Restoration of native vegetation communities and enhancement of connectivity would improve long-term survival opportunities for this species.
Edge effects	Edge habitats may contribute to isolation and increased predation on this snake.
Water quality	Water quality may result in changes in soil texture and the invertebrate community.
Land use history	Historical agriculture likely rendered areas unsuitable for use by this species; the long-term effects of agriculture are unknown.
Roads	Dispersal by this snake may be impacted adversely by roads, ditches, and areas with unsuitable soils.
Species Characteristics	
Dispersal mechanism	Habitat and the potential for dispersal by this snake may have been altered in important ways we do not understand. The goal of restoration would likely require the creation of functioning desert ecosystems with soils and vegetation communities historically available to this species.
Life history/Population data	Essentially nothing is known about the demographics or population dynamics of this species. Habitat requirements are not known, except that this snake requires undisturbed desert communities.
Seasonal specialization	The prey animals of this species are clearly seasonal in abundance, so the snake must have the ability to switch prey as necessary.

Table 4.5-5. Potential and Current Threats and Stressors for Tucson Shovel-Nosed Snake (Continued)

Stressor/Threat	Relevance to Species
Species Characteristics (Continued)	
Captive breeding/ translocation potential	Although a potentially useful approach, the potential for successful captive breeding and restoration is unknown.
Breadth of resource use	This snake appears to specialize in a narrow range of resources, but this is not well understood.
Adaptability	Habitat selection apparently is limited by available soils.
Predation	The effects of predation on this snake are unknown.
Disease	The effects of disease are unknown.
Competition	A potential factor in the decline of this snake may be competition from the morphologically, ecologically, and behaviorally similar banded sand snake (*Chilomeniscus cintus*), which appears to have moved into the area occupied previously by shovel-nosed snake.
Domestic/feral animals	Not likely to be a problem.
Anthropogenic Factors	
Fire threat	Fires may negatively impact this species by resulting in loss or conversion of vegetation.
Off-road vehicles	ORVs may impact snakes directly or indirectly, through impacts to soils.
Grazing	Grazing may be harmful if it reduces vegetation diversity or compacts soils.
Collection/hunting	Collection of snakes may have been a problem historically, but is no longer considered a problem because snakes have not recently been found in area.
Insecticides	Insecticides are not thought to be a problem, except to the extent that they affect prey base for this species.
Direct take/mortality	Direct take of this snake is not considered a problem.
Dumping	Illegal dumping may actually benefit this species by providing cover.
Increased road density	Increased road density results in loss of habitat, barriers to dispersal, and direct mortality.
Connectivity	
Fragmentation	Fragmentation is probably a significant problem for this snake because the only remaining habitat is isolated.
Barriers	Potential barriers to dispersal by this snake include roads, ditches, agricultural fields, urban development, and other unsuitable habitats.
Traffic volumes	Vehicular collisions are a serious problem, at least historically.
Habitat patchiness	Connectivity is considered crucial for the long-term maintenance of viable populations.

CURRENT MANAGEMENT RECOMMENDATIONS

Rosen (2004) suggests that the persistence of this species in Avra Valley requires that most, or all, of the few remaining areas of "relatively undisturbed creosote bush and creosote bush-mesquite upland desertscrub" be preserved.

Among the areas Rosen (2003b) recommends for conservation are (also see Figure 4.5-3)

- **Site 2:** Brawley Flats—The least-disturbed remaining patch of desert within the local distribution of the Tucson shovel-nosed snake. Much of the area has been heavily damaged by past land uses and parcels are in various stages of recovery. Several City-owned parcels, including the Weinstein, Lupori, and Reeves Farms (north and south) parcels, include portions of or are adjacent to the Brawley Flats.
- **Site 3:** Magee-Avra Roads Desert Flats—Adjacent to the Brawley Flats, this area also includes tracts of relatively undisturbed desert within the local distribution of the snake. Impacts in this area include wildcat development and overgrazing. A few City-owned parcels, including Lupori, Reeves (north), Comisky, and Levokitz Farms parcels, include or are adjacent to portions of the flats.

- **Site 4:** Trico-Brawley Flats and North Silverbell Ridge—Patches of high-quality mesquite and creosote bush habitat can be found in this area. This area has been impacted by past land uses and continues to be affected by urban sprawl. Several City-owned parcels are located in the general vicinity, including the former Gin, Hurst, and Simpson Farms south.

4.5.5 Potential Impacts of the City's Proposed Activities

DIRECT EFFECTS

Urban development, including construction of water supply and capital improvement projects, can cause direct mortality or injury to Tucson shovel-nosed snakes.

INDIRECT EFFECTS

Tucson shovel-nosed snakes that are displaced by construction activities could experience higher mortality while searching for suitable, unoccupied habitat. Roads and increased traffic on roads can increase mortality of snakes from vehicle strikes. Over the long-term, conversion of suitable habitat to urban uses could result in take of snakes through a variety of mechanisms, including reduced foraging opportunities, reduced or degraded denning opportunities, and increased predation.

POTENTIAL HABITAT CHANGES IN THE PLANNING AREA

Once suitable habitat with relatively undisturbed soil conditions is graded for development, its potential value to this species is lost. As proposed in the City Water Plan, planned public water infrastructure projects could directly impact all suitable Tucson shovel-nosed snake habitat in the Avra Valley planning area. Given the uncertainty in the City Water Plan regarding the types and scope of projects that may be constructed within the Avra Valley planning area, we are assuming a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, capital improvement projects, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside of the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in additional habitat loss or fragmentation within these properties. Without knowing the final location and design of any of these facilities, we cannot say that any habitat in Avra Valley will not be impacted in some fashion by these covered activities.

POPULATION LEVEL EFFECTS

Because it is not known whether this species persists in the City HCP planning area, the population effects of the City's proposed activities are unknown.

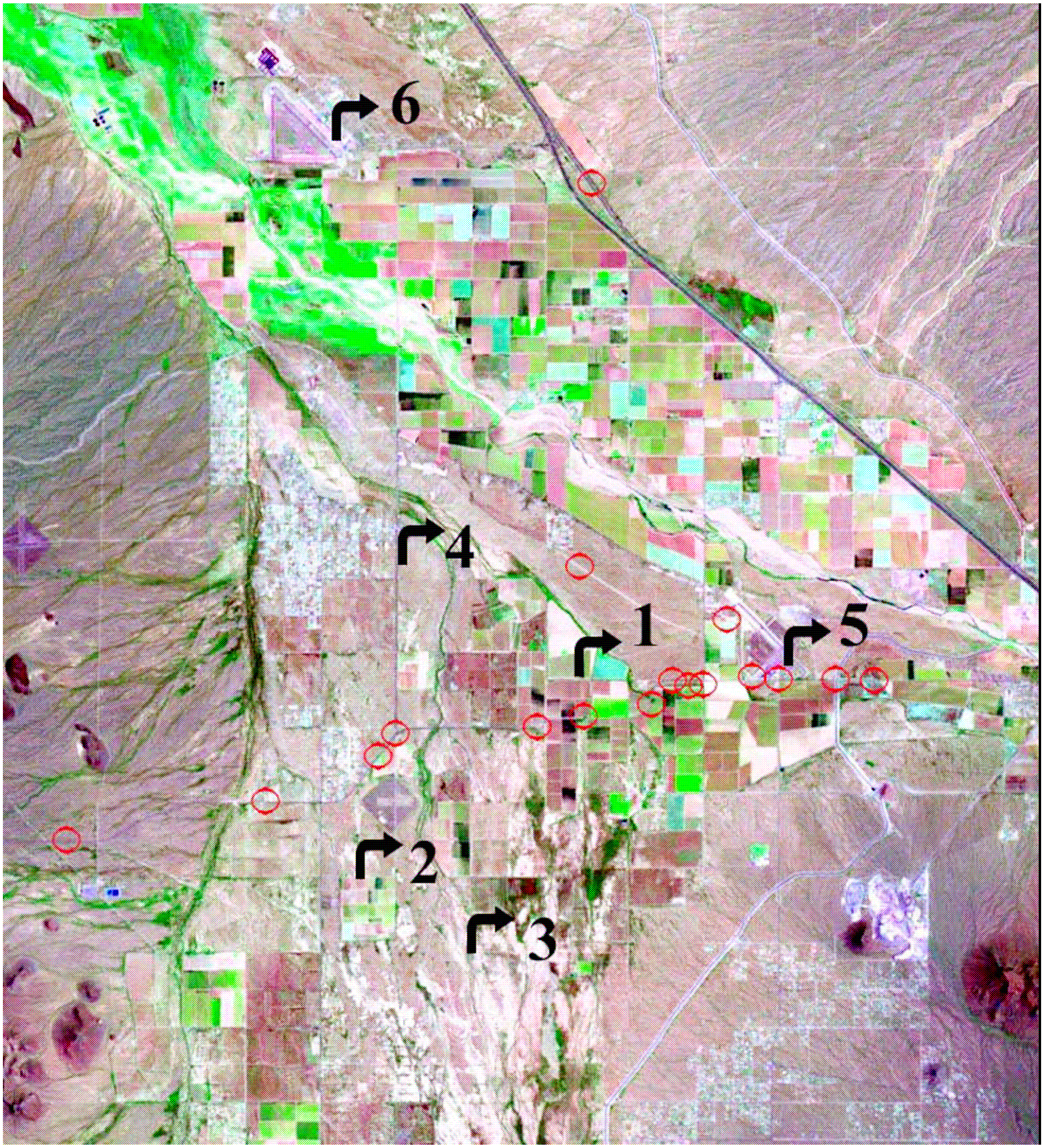

Figure 4.5-3. Museum records and potential conservation areas mapped onto a 1993 aerial image of the northern Avra Valley. The habitat associations at museum localities for the Tucson shovel-nosed snake (red ovals) may be inferred, although agricultural expansion (green–active; reddish–recovering) has obliterated desert habitat formerly occupied by snakes. Arrows point toward potential conservation areas, with numbers corresponding to discussion in the text. Base image source: University of Arizona ART lab, School of Renewable Natural Resources. Source: Rosen (2003b).

4.6 Ground Snake (Valley Form) (*Sonora semiannulata*)

4.6.1 Population Distribution, Taxonomy, and Status

RANGE AND DISTRIBUTION

This range of the ground snake (*Sonora semiannulata*) extends from southwestern Idaho south through western and southern Arizona; eastward through much of west and central Texas including nearly all of Oklahoma; and south through north-central Mexico. Rosen (2004) provides a map (Figure 4.6-1) of the species' known distribution in Pima County and adjoining areas. The ground snake is found from sea level to around 6,000 feet (1,830 meters) (Stebbins 1985).

TAXONOMIC UNIQUENESS

Current taxonomy recognizes only one species with no subspecies. The ground snake, however, has distinctive and potentially isolated forms throughout its range. Recon (2002) describes three forms as occurring within Pima County, but the degree of genetic separation among these forms is unknown. The ground snakes in the Tucson area are described as the "valley form"; Rosen (2003a) uses the term "population segment" in referring to this population. He notes that color pattern phases tend to differentiate the mountain and valley forms of the snake, but not with complete certainty (Rosen 2004).

POPULATION STATUS AND THREATS

The population status of this species in Arizona and Pima County is unknown. This species is not tracked within the AGFD HDMS. Although recent surveys have confirmed that ground snakes persist within the range of the valley form (Rosen 2004), the population status is unknown.

Rosen (2003a) believes that habitat destruction, particularly in Pinal County, could be adversely affecting the local population. Other threats are likely to be similar to those for other snakes, and include:

- Agriculture and urban development;
- New road construction;
- Increased traffic on new and existing roads;
- ORV activity; and
- Scientific and commercial collection.

The snake has also been observed trapped in cattle guards (BISON-M 2004a).

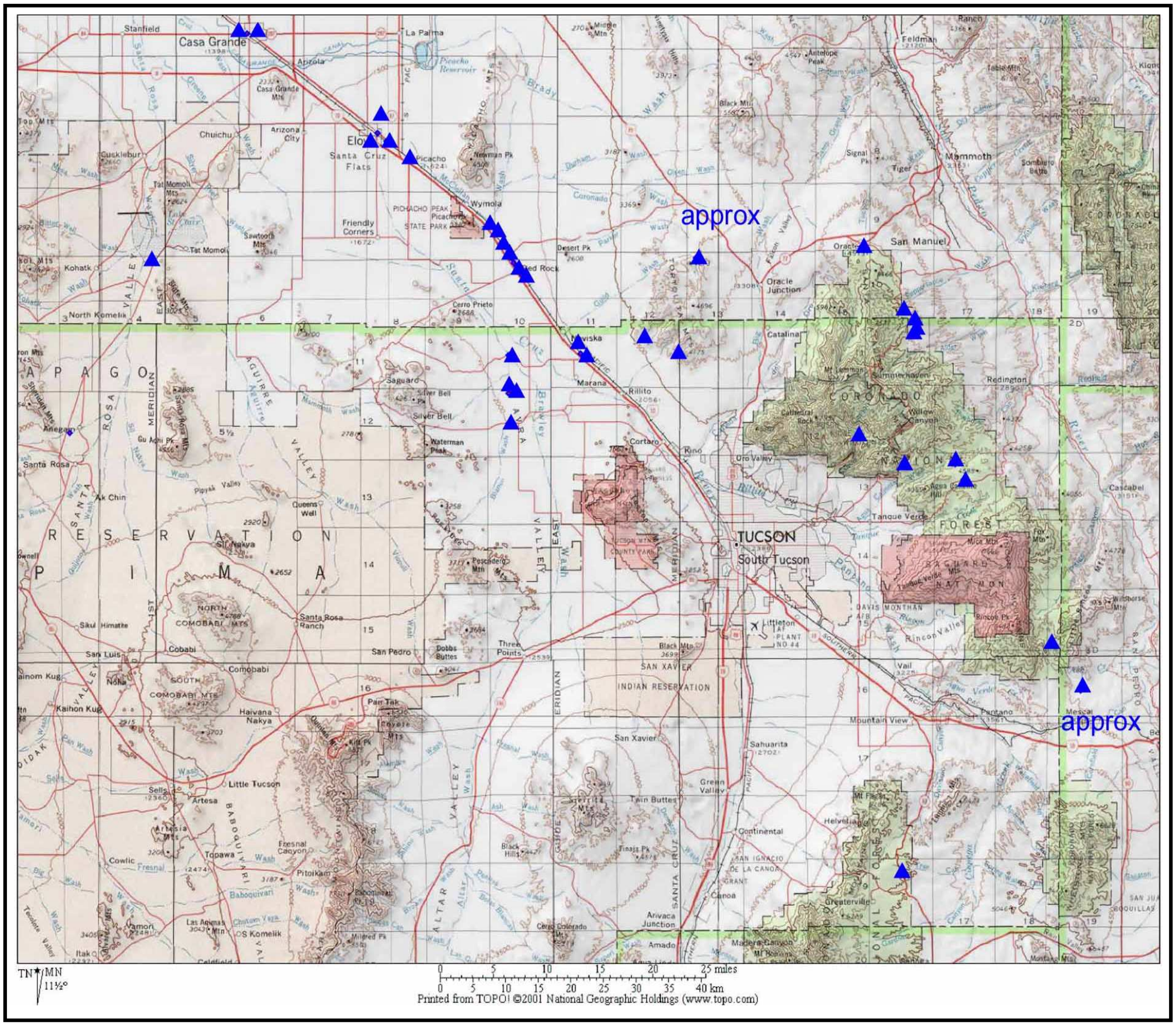

Figure 4.6-1. Distribution of ground snake (*Sonora semiannulata,* valley form) in eastern Pima County and adjoining areas based on plottable museum records, 1900–2004, and observations and reliable records obtained by the author. Records occur in two environments: valley flats (mesquite- and grass-dominated desertscrub) and lower mountain slopes (Semidesert Grassland and upper edge of Arizona Upland Desertscrub). Base image from Topo digital mapware. (Reproduced from Rosen 2004).

4.6.2 Ecology

LIFE HISTORY

The ground snake is a small, secretive, nocturnal snake whose prey includes insects, scorpions, centipedes, crickets, and grasshoppers (Rosen 2003a; Stebbins 1985). Unlike other closely related snakes, the ground snake is not morphologically adapted to digging (Rosen 2004). Clutches of four to six eggs are laid in June through August. This species is active during April through October and hibernates in underground dens during the winter (Stebbins 1985).

HABITAT REQUIREMENTS

The ground snake occupies desert valleys on hard clays and silts that digging snakes, such as shovel-nosed snakes, do not usually occupy (Rosen 2003a). Ground snakes are known from fine soils on flats and from very coarse, gravelly soils on lower rock slopes in desert grassland. Over its range, the species occurs in river bottoms, desert flats, sand hummocks, and rocky hillsides where there are pockets of loose soil. Vegetation in these areas is typically sparse (e.g., creosote bush desertscrub), but along the lower Colorado River this snake occurs in thickets of mesquite (Stebbins 1985). Rosen (2004) recently described the valley form's habitats as valley flats of mesquite and grass-dominated desertscrub, and lower mountain slopes of Semidesert Grassland and Arizona Upland Desertscrub.

Small snakes, including members of the Colubrid family, tend to have fairly small home ranges. Data for related species indicate that home ranges for colubrid snakes are usually significantly less than one hectare (2.5 acres) in size (NatureServe 2005). These snakes are still capable of moving relatively large distances, with reports of some individuals dispersing as far as 1.7 kilometers (1.1 miles) (NatureServe 2005).

In the Phoenix metropolitan area, ground snakes are known to occupy urban environments. The population does best in open areas with established vegetation, including landscaped areas that are untended by typical landscape management practices (P. Rosen, pers. comm.). However, there is no evidence that the valley form of this species occupies urban environments in Pima County (Recon 2002).

4.6.3 Baseline Conditions

CITY POPULATION STATUS

There are no known observations of ground snakes within the Avra Valley planning area. Four historical records of the ground snake show that it occurs along the Blanco Wash, from the confluence with the Santa Cruz River south to Avra Valley Road. Although these three observations serve to confirm the presence of this snake in the vicinity of the City's HCP planning area, they are not sufficient to determine the local abundance or population status of the species.

HABITAT IN AND NEAR THE PLANNING AREA

Two different models have been developed to delineate potential habitat for the ground snake:

- The SDCP habitat model and
- A habitat model developed by Dr. Rosen for the Town of Marana HCP.

SDCP Habitat Model. A habitat model for the ground snake was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following four primary variables:

- Vegetation;
- Slope;
- Elevation; and
- Landform.

The habitat potential of the categories of each variable was ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high-potential habitat. The four variables were combined to provide an overall habitat potential. Table 4.6-1 shows the specific categories of the variables considered to provide habitat for the ground snake and their habitat potential ratings.

Table 4.6-1. Value Ratings for Characteristics of the Variables Used in the SDCP Ground Snake Habitat Model

Variable/Category	Value Rating
Vegetation	
Great Basin Conifer Woodland Piñon-Juniper (122.41)	1
Madrean Evergreen Forest and Woodland Encineal (Oak) (122.31)	1
Madrean Evergreen Forest and Woodland Xeroriparian Encineal (Oak) (122.31XR)	1
Sonoran Riparian Woodland Xeroriparian Mesquite (124.71XR)	2
Interior Chaparral Manzanita (133.32)	1
Interior Chaparral Mixed Evergreen Sclerophyll (133.36)	1
Scrub-Grassland (Semidesert Grassland) Sacaton-Scrub (143.14)	2
Scrub-Grassland (Semidesert Grassland) Mixed Grass-Scrub (143.15)	2
Scrub-Grassland (Semidesert Grassland) Scrub-Shrub Disclimax (143.16)	1
Scrub-Grassland (Semidesert Grassland) Xeroriparian biome (143.10XR)	2
Scrub-Grassland (Semidesert Grassland) Xeroriparian Scrub-Shrub Disclimax (143.16XR)	1
Scrub-Grassland (Semidesert Grassland) Urban Mixed Grass-Scrub (143.15U)	1
Sonoran Desertscrub Saltbush (154.17)	1
Interior Southwestern Riparian Deciduous Forest and Woodland Cottonwood-Willow (223.21)	1
Sonoran Riparian and Oasis Forests Mesquite (224.52)	1
Sonoran Riparian and Oasis Forests Cottonwood-Willow (224.53)	2
Sonoran Riparian and Oasis Forests Urban Cottonwood-Willow (224.53U)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	2
Sonoran Deciduous Swamp and Riparian Scrub Mixed Scrub (234.71)	2
Sonoran Deciduous Swamp and Riparian Scrub Saltcedar Disclimax (234.72)	2
Sonoran Deciduous Swamp and Riparian Scrub Urban biome (234.70U)	1
Slope	
0%–2%	1
2%–5%	1
5%–10%	1
10%–15%	1
Elevation	
195–400 meters	1
401–600 meters	3

Table 4.6-1. Value Ratings for Characteristics of the Variables Used in the SDCP Ground Snake Habitat Model (Continued)

Variable/Category	Value Rating
Elevation (Continued)	
601–800 meters	3
801–1,000 meters	2
1,001–1,200 meters	2
1,201–1,400 meters	2
1,401–1,600 meters	2
1,601–1,800 meters	1
1,801–2,000 meters	1
2,000 meters and above	MASK
Land Form	
Drainageways	3
Streambeds	3
Floodplains	3
Terraces	3
Non-dissected alluvial plains	2
Dissected alluvial plains	2
Non-dissected bajadas and fans	1
Dissected bajadas and fans	1
Non-dissected pediments	1
Dissected pediments	1
Hills with low relief	1

Source: Recon (2002) *Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan*.

Town of Marana HCP Habitat Model. Rosen (2004) recently concluded that ground snakes formerly occupied narrow bands of habitat on the periphery of the valley center where bajada washes discharged water and fine sediment onto dense xeroriparian plains.

A habitat model for this snake, developed by Dr. Rosen for the Town of Marana HCP, consisted of three primary variables: 1) land use; 2) elevation; and 3) soils. A series of categories was then assigned to each of these variables, and each category was ranked as 0, 1, 2, and 3, with 0 indicating that the category provides no habitat value and 3 indicating that the category provides high habitat value. The three variables were combined to provide an overall habitat value for a given area (Table 4.6-2).

Table 4.6-2. Habitat Model for the Ground Snake (Valley Form)

Variable/Category	Value Rating[1]
Soils	
Silty clay loam	3
Gila loam	3
Gravelly loam	1
Slope (applies only to gravelly loam soils)	
0 to 3 degrees (about 6.5%)	Mask
> 3 degrees	1
Vegetation	
Active agriculture	Mask[2]

[1] Value ratings recommended by Dr. Phil Rosen.

[2] Active agriculture does not constitute potential habitat in its current state. These areas can be managed in the future, however, in a manner that improves their potential as ground snake habitat.

Dr. Rosen concluded that soils provide the best overall predictor of habitat for ground snakes. Potential habitat identified by the presence of gravelly soils was further refined using slope. Vegetation and landform characteristics, however, did not appear to improve the predictive value of the model. Active agricultural land was identified as having no habitat potential. The ground snake habitat model developed for the Town of Marana HCP by Dr. Rosen was considered to be as accurate and appropriate for identifying habitat within the Avra Valley HCP planning area as it had been for use in the Town of Marana HCP planning area. The Marana model was adjusted based on Dr. Rosen's conclusions that the Brawley Wash lands do not contain suitable habitat. Silverbell Road and Avra Valley Road has been adequately confirmed. The Brawley flats, which cover portions of a number of additional City-owned lands, could also provide potential habitat for the ground snake; however, no individuals have been recorded in this area and restoration be needed to enhance the potential of these lands to support snakes (Rosen 2004). Most recently, according to Dr. Rosen:

> *In contrast [to the Blanco Wash lands], Brawley Wash lands, which have been stripped of sand and silt by channelization and drainage, leaving behind hard adobe soils, are, insofar as has been determined, un-occupied by this species. There appears to be too much erosion, and not enough pooling to provide suitable habitat (Rosen 2008).*

Since lands part of the Brawley Wash system do not currently contain suitable habitat, they have been classified as "potential habitat with restoration." Should additional mitigation lands become necessary to meet requirements described in Chapter 5, these restoration potential lands would be considered. The output of the adjusted habitat suitability model for the ground snake is shown in Figure 4.6-2. Based on this habitat model, 1,192 acres of potential ground snake habitat is predicted to occur in the Tucson planning area (Table 4.6-3).

Table 4.6-3. Acreage of Potential Ground Snake Habitat for Each Suitability Class

Habitat Suitability Class	Avra Valley (acres)
Potential Suitable Habitat	1,192
Potential Habitat with Restoration	3,320
Total Acres	**4,512**
Total Planning Area Acres	**19,821**

Table 4.6-4. Potential and Current Threats and Stressors for Ground Snake

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Loss of habitat to agricultural and urban development is regarded as the most serious historical threat to the species. Loss continues today, to a lesser degree, as urban development occurs in previously undeveloped land that may still support this species.
Dispersal	Dispersal is limited for a small snake. The ability to disperse has been compromised by roads, developed areas, irrigation and drainage ditches, and areas with impacted soils.
Foraging	Size of foraging area is unknown, may be related to available food supply and available suitable soils; diversity of resources is important.
Diurnal shelter	Uses rodent burrows and litter (e.g., boards) as shelter for unknown periods of time; rodents have largely been eradicated as a result of agricultural and urban development from areas where this snake once lived.
Fire threat	May be a threat if it results in loss or conversion of vegetation; direct effects of fire on snake are unknown, probably lethal under some circumstances, not under others.
Habitat Alteration	
Prey	Consumes diverse invertebrate prey; loss or reduction of populations of suitable prey species through habitat loss and invasive competitors is probably a significant threat but needs further research.
Vegetation composition/density	Loss of native floodplain vegetation by conversion to agricultural fields was an important cause of population loss.
Habitat conversion	Loss of native floodplain vegetation by conversion to agricultural fields was an important cause of population loss.
Fragmentation	Fragmentation of historic habitat may have led or contributed to endangerment of this species; remaining potentially suitable areas are isolated by various barriers.
Invasive plant species	Invasion by mesquite, buffelgrass, and red brome reduces vegetation diversity and can lead to fires, changes in soil characteristics, and prey availability.
Invasive animal species	Effects are unknown, but concern has been expressed about invasive non-native insects such as cockroaches out-competing native food animals.
Habitat rehabilitation potential	Anything that restores native vegetation is beneficial; habitat rehabilitation to enhance connectivity may improve long-term survival if the species is present or reintroduced.

Table 4.6-4. Potential and Current Threats and Stressors for Ground Snake (Continued)

Stressor/Threat	Relevance to Species
Habitat Alteration (Continued)	
Flood	May result in loss of individuals and/or areas that were formerly inhabited; much of this species' natural habitat gets flooded occasionally, and under natural conditions snakes survive, but flood regime has been altered by human activities so that floodplains in part of the historical range may remain under water for longer periods than before alteration, and the effect on snakes is unknown.
Groundwater depletion	May have led to loss of suitable habitat in the past and may impede restoration of suitable habitat.
Edge effects	Unknown, but may contribute to isolation and predation on snake.
Fire threat	May be a threat if it results in loss or conversion of vegetation; direct effects of fire on snake unknown, probably lethal under some circumstances and not under others.
Water quality	Water quality is probably irrelevant, but may result in changes in soils and invertebrate community.
Land use history	Historic agricultural use may render land unsuitable for this species; long-term effects are unknown.
Species Characteristics	
Dispersal mechanism	Moves overland, apparently preferring certain types of soil; dispersal may be impacted adversely by roads, ditches, and unsuitable areas.
Habitat rehabilitation potential	Habitat rehabilitation potential for this snake is unknown. Its habitat may have been altered in important ways that we do not understand. Because the goal of rehabilitation for this species would be to restore fully functioning floodplain environments to historically suitable habitat, the potential for success is unknown.
Life history/population information	Essentially nothing is known about demographics or population dynamics of this snake. Other than its preference for undisturbed floodplain communities, specific habitat requirements are not known.
Seasonal specialization	Unknown, prey animals are clearly seasonal in abundance and life cycle, so snake must have the ability to switch prey.
Breadth of resource use	Appears to specialize in a narrow range of resources, but this is not well understood.
Adaptability	Fairly limited in habitat selection to specific soil types.
Interspecific Factors	
Invasive species	The effects of invasive species are unknown; however, invasive plants alter habitat adversely and invasive insects may alter the snake's prey base.
Anthropogenic Factors	
Fire threat	May be a threat if it results in loss or conversion of vegetation; direct effects of fire on snake are unknown, probably lethal under some circumstances and not under others.
Off-road vehicles	ORVs may impact snakes directly or indirectly through compaction of soil and/or potential burrows.
Grazing	Grazing may be harmful if it reduces vegetation diversity.
Collection/hunting	Collection may have been a problem historically, but is no longer considered a problem because snakes have not been found recently in the area.
Pesticides—impacts to prey	Pesticides may affect the prey base for this species.
Direct take/mortality	Direct take is not considered a problem.
Increased road density	An increase in number of roads results in loss of habitat, barriers to dispersal, and direct mortality. Mortality from vehicles is a serious problem, at least historically.
Connectivity	
Fragmentation	This is probably a significant problem because the only remaining habitat is isolated.
Barriers	Effective barriers to the movement of snakes include roads, ditches, agricultural fields, urban development, and patches of unsuitable habitat.
Habitat patchiness	Connectivity of suitable habitats is considered crucial to this species.

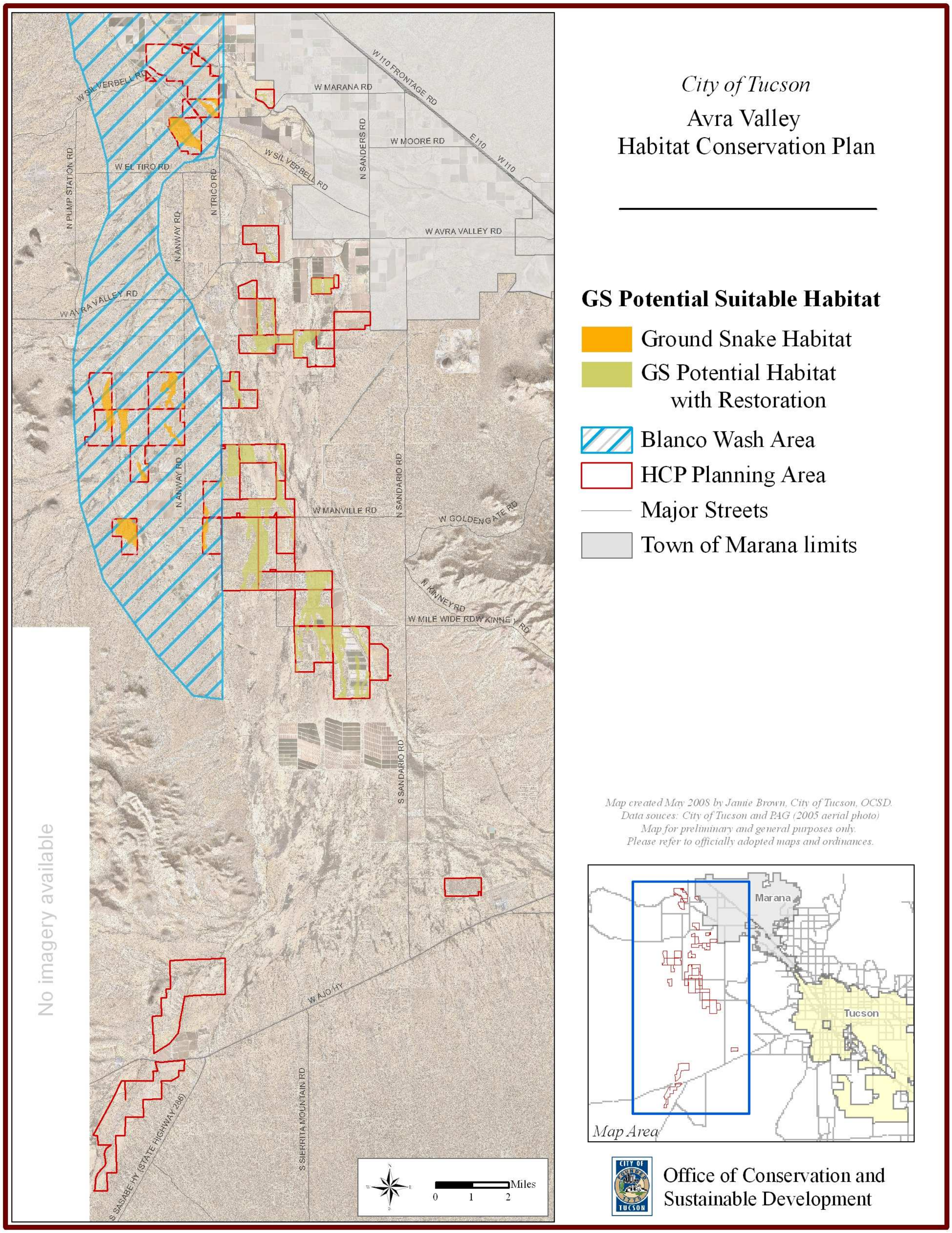

Figure 4.6-2. Habitat suitability model for the ground snake in eastern Pima County based on soil type determined from pre-2003 records (Rosen 2004)

CURRENT MANAGEMENT RECOMMENDATIONS

Rosen (2004) notes that, in Phoenix, the ground snake does occur in residential developments, using gardens, lawns, and mesic landscaping, especially those with native plants such as mesquite or riparian species. The biggest hurdle to maintaining ground snake populations in areas that are being developed is the high potential mortality rate resulting from grading or other surface disturbance activities (Rosen 2004). In order to minimize impacts of development on the snake, Rosen (2004) recommends that areas intended for open space, landscaping, or other less intensive uses should not be bladed. Areas with mesquite should be preserved on-site.

4.6.5 Potential Impacts of the City's Proposed Activities

The City and vicinity represent a small and likely inconsequential portion of this widely distributed range of this species (i.e., much of the western U.S. and north-central Mexico). The range of the "valley form" of the ground snake under consideration here extends north to Eloy and the snake is likely most abundant around Red Rock (see Figure 4.6-1).

DIRECT EFFECTS

Land development, including construction of water projects as part of the covered activities, can cause direct mortality or injury to snakes. According to Dr. Phil Rosen ". . .With regard to mitigation, attempts to save individual animals in areas undergoing residential or commercial construction remain infeasible for small, secretive animals like snakes. If populations are to be saved in situ, use of heavy equipment must be carefully regulated and monitored" (2008).

INDIRECT EFFECTS

Snakes that are displaced by construction activities could experience higher mortality while searching for suitable, unoccupied habitat. Roads and increased traffic on roads can increase mortality of snakes from vehicle strikes. Over the long-term, conversion of suitable habitat to developed areas could result in take of snakes through a variety of mechanisms, including reduced foraging opportunities, reduced or degraded denning opportunities, and increased predation.

POTENTIAL HABITAT CHANGES IN THE PLANNING AREA

Conversion of existing undeveloped potential habitat to development would have an adverse effect on the snake, but the effect on this species of converting agricultural lands to development is unclear. In the Phoenix metropolitan area, ground snakes are known to occupy urban environments. The population does best in open areas with established vegetation, including landscaped areas that are untended by typical landscape management practices (P. Rosen, pers. comm.). However, there is no evidence that the valley form of this species occupies urban environments in Pima County (Recon 2002), so it is unclear as to what extent the conversion of agricultural fields to water development projects might render existing habitat unsuitable for ground snakes. We are assuming, for purposes of this analysis, that the construction of water development projects would render the entire parcel unsuitable for the snake.

As proposed in the City Water Plan, planned public water infrastructure projects could directly impact all suitable ground snake habitat in the Avra Valley planning area. Given the uncertainty in the City Water Plan regarding the types and scope of projects that may be constructed within the Avra Valley planning area, we are assuming a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside of the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in additional habitat loss or degradation within these properties. Without knowing the final location and design of any of these facilities, we cannot say that any habitat within the Avra Valley planning area will not be impacted in some fashion by these covered activities.

POPULATION-LEVEL EFFECTS

The potential effect of covered activities on the ground snake is uncertain because the current distribution and abundance of the species in the planning area is unknown. In the Phoenix area, the species is known to persist in urban and modified environments, and in New Mexico the species has been reported to tolerate or benefit from human developments, including farm outbuildings (barns, silos, and sheds), and abandoned buildings (BISON-M 2000 in Recon 2002). Based on these observations, ground snakes could persist in portions of the Avra Valley HCP planning area following development. However, no specific information is available with respect to the tolerance of the ground snake to human development and activity (Recon 2002).

4.7 Pale Townsend's Big-Eared Bat (*Corynorhinus townsendii pallescens*)

4.7.1 Population Distribution, Taxonomy, and Status

RANGE AND DISTRIBUTION

Pale Townsend's big-eared bat (PTBB) ranges throughout western North America from southern British Colombia south along the Pacific coast to southern California, from the Black Hills of South Dakota to western Texas, and through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico. It is not known from the Baja California Peninsula. Isolated occurrences in the southern Great Plains, Ozark Mountains, and Appalachian Mountains are considered to be relict populations.

The species is widespread throughout Arizona, although it is not considered common anywhere, and is least common in northeastern grasslands and southwestern desert areas. It has been found from 550 to 7,520 feet (168 to 2,294 meters) in elevation. Most records, however, come from above 3,000 feet (915 meters) (Hinman and Snow 2003). In Arizona, PTBB have been reported in Cochise, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, and Yuma counties (Figure 4.7-1).

TAXONOMIC DISTINCTNESS

The *Corynorhinus* genus, which has been the accepted generic name for most of the taxonomic history of the species, was relegated by Handley (1959) to subgeneric status under the genus *Plecotus* (AGFD 2003c; BISON-M 2004a). After several morphological, phylogenetic, and genetic evaluations (see Bogdanowicz et al. 1998; Frost and Timm 1992; and Tumlinson and Douglas 1992), *Corynorhinus* was re-elevated to full genus status (AGFD 2003c).

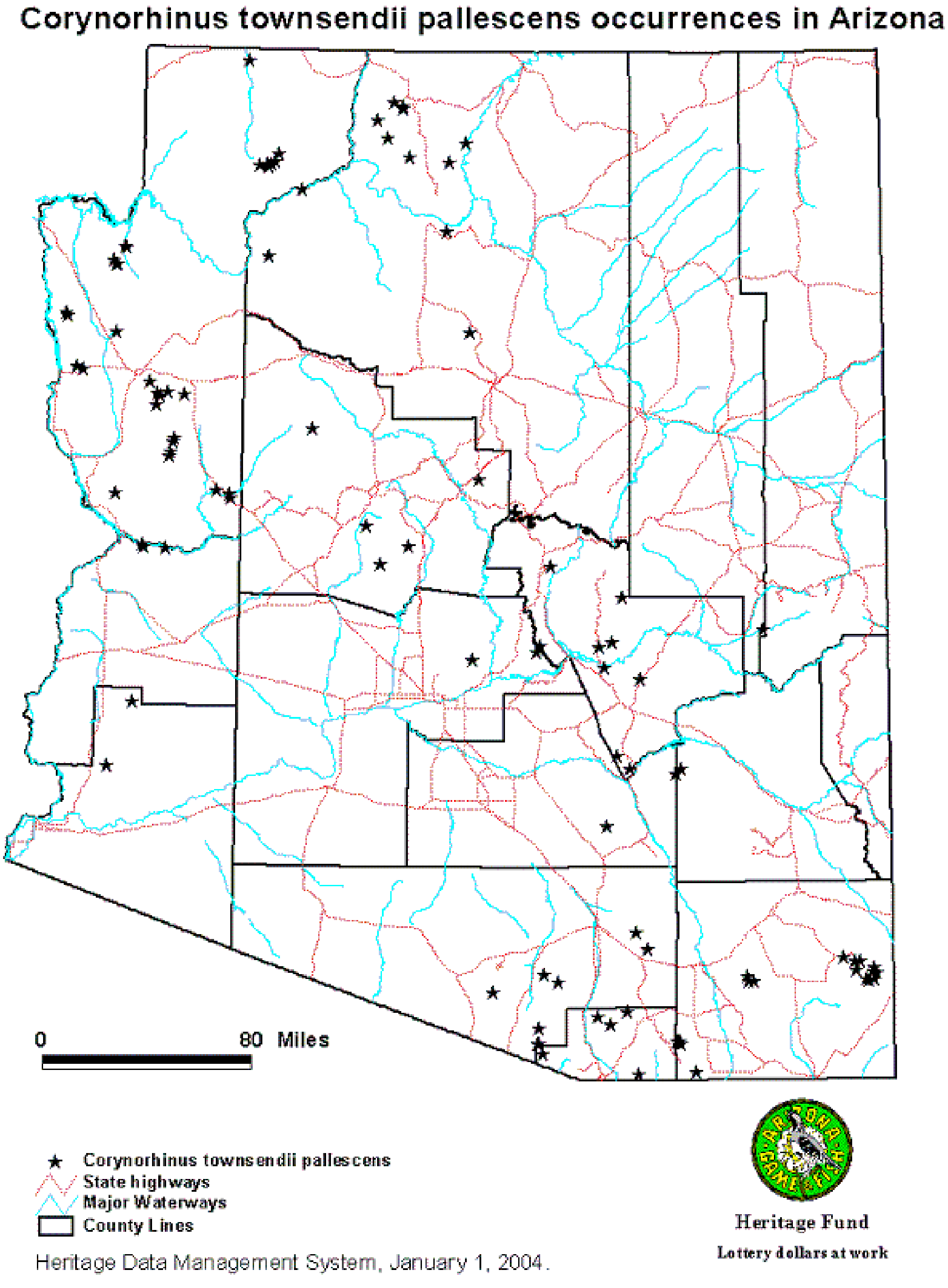

Figure 4.7-1. Habitat range and occurrence of pale Townsend's big-eared bat in Arizona. Points represent maternity colonies, roosts of five or more individuals, sites where five or more males have been netted, and sites where pregnant or lactating females have been netted.

PTBB is one of five subspecies currently recognized under *C. townsendii* (AGFD 2003c; BISON-M 2004a). Three of the subspecies, *C. t. virginianus* (Virginia big-eared bat), *C. t. ingens* (Ozark big-eared bat), and *C. t. australis*, do not occur in the western U.S. (BISON-M 2004a; Kunz and Martin 1982; USFWS 1992). *C. t. townsendii*, known variously as the Pacific Western big-eared bat or Western big-eared bat, occurs in Washington, Oregon, California, Nevada, Idaho, and possibly northwest Utah and southwest Montana (BISON-M 2004a; USFWS 1992). *C. t. pallescens* is found in the same states as *C. t. townsendii* and also occurs in Arizona, Colorado, New Mexico, Texas, and Wyoming (BISON-M 2004a). However, taxonomic understanding of this complex is still evolving, and recent work suggests that *C. t. pallescens* will likely become *C. t. townsendii*. *C. t. pallescens* will be designated as the subspecies restricted to northern New Mexico and Colorado, while *C. t. townsendii* will be the subspecies in Arizona (Piaggio and Perkins 2005).

Although there are areas in which only one of the two Western subspecies apparently occurs, the two subspecies intergrade throughout much of their range and, in these intergrade zones, individuals cannot easily be assigned to subspecies (BISON-M 2004a; Pierson and Rainey 1994). As a result, some authors do not distinguish between the two Western subspecies, instead choosing to lump them into a single taxon, *C. t. townsendii* or the Townsend's big-eared bat (Hutson et al. 2001; Pierson and Rainey 1994).

POPULATION STATUS AND THREATS

Range-Wide Population Status and Threats. The two eastern subspecies, *C. t. virginianus* and *C. t. ingens*, were listed as endangered in 1979, primarily as a result of severe population declines and restriction of breeding habitat to only a few caves (USFWS 1979). In 1994, *C. t. pallescens* and *C. t. townsendii* were recognized as Category 2 Federal Candidates, now referred to as Species of Concern (BISON-M 2004a).

The overall population status and trend of the PTBB is uncertain, but the species is believed to have declined in parts of its range. A survey by Pierson and Rainey (1994) suggested that substantial population declines in PTBB have occurred in California over the last 40 to 60 years, based on the following: 1) a 52 percent loss in the number of maternity colonies; 2) a 44 percent decline in the number of roosts; 3) a 55 percent decline in the number of bats; and 4) a 32 percent decrease in the average size of remaining colonies. The lower Colorado Desert along the Colorado River, an area that experiences heavy recreational use, is one of three areas in California in which marked declines in the numbers of PTBB colonies have taken place.

The PTBB is threatened by human disturbance at major maternity roosts; mining, closure, and sealing of abandoned mines; vandalism at maternity and hibernation sites; loss of foraging habitat; and possibly, exposure to pesticides (AGFD 2003b). PTBB are extremely sensitive to human disturbance, and simple entry into a maternity roost can result in the abandonment of the site (Pierson et al. 1991). Because this bat feeds heavily on Noctuid moths, which require wetland habitats, a decline in wetland habitats could contribute to a decline in the bat population.

Pale Townsend's big-eared bats are extremely sensitive to human disturbance, and simple entry into a maternity roost can result in the abandonment of the site (Pierson et al. 1991). Because this bat feeds heavily on Noctuid moths, which require wetland habitats, a decline in wetland habitats could contribute to a decline in the bat population.

Arizona Population Status and Threats. Population trends for Townsend's big-eared bats in Arizona are unclear, but losses of and reductions in bat numbers at maternity colonies have been reported (Hinman and Snow 2003). Pierson and Rainey (1994) reported that only 13 maternity roosts have been verified in Arizona. These 13 sites represent 10 separate colonies, totaling about 1,000 adult females. More than one-half the sites are in mines, and only four are known to contain more than 200 individuals (Recon 2002).

According to more recent reports, only five to seven maternity colonies, ranging in size from 100 to several hundred bats, are currently known (Recon 2002). The largest colony in Arizona, Stanton's Cave in the Grand Canyon, disappeared in the 1970s shortly after the roost site was gated to protect archeological and paleontological remains. After the gate was modified in the mid-1980s, several bat species (but not *C. townsendii*) were observed inside the site (Recon 2002). Current bat use of these sites is not known (AGFD 2003b).

Maternity sites for the species have been found at Agua Caliente Cave, Dixie Mine, Crystal Cave, Stanton's Cave in Grand Canyon National Park, the Chiricahua Mountains, a cave in Sycamore Canyon, a cave near Union Pass, and a cave in Hereford, although not all these sites remain in use (BISON-M 2004b; Castner et al. 1994; Dalton and Dalton 1994). PTBB hibernacula have been located within the Gold Button Mining Claim in Prescott National Forest (one site) and along the Bill Williams River (two sites) (Castner et al. 1994; Snow et al. 1995).

Mist net and roost surveys during the 1990s (see BISON-M 2004b; Castner et al. 1994; Snow and Castner 1996; Snow et al. 1996, 1995) yielded PTBB records in numerous locations, including:

- Apache-Sitgreaves, Coconino, Coronado, Prescott, Kaibab, and Tonto national forests;
- Cave and Walnut creeks;
- Klondyke Mine;
- Arivaca and Duquesne quads in Santa Cruz County;
- McDowell Peak Quad in Maricopa County;
- Harcuvar Mountains (Happy Day Pond);
- Harquahala Mountains (Browns Canyon Spring);
- In foothills southeast of Kingman (Boulder Well);
- Along the Bill Williams River;
- Batamote Hills, Helvetia, and Stevens Mountain quads in Pima County; and
- PTBB have also been found roosting under bridges in Arizona (BISON-M 2004b).

4.7.2 Ecology

LIFE HISTORY

PTBB are active in summer but hibernate in winter. They mate in autumn and winter and sperm is stored in the female's reproductive tract until spring. Fertilization occurs at the time of ovulation. Males produce few sperm in their first autumn and are considered to be largely sterile and probably non-breeding. In contrast, females breed in their first autumn and bear young the following summer. Gestation varies from 56 to 100 days after fertilization, depending on climatic conditions and the resultant metabolic rates of the females (i.e., development slows when females go into daily torpor). In summer, females form maternity colonies of 12 to about 200; males, however, roost alone or in small groups (as many as three individuals) (Pierson and Rainey 1994; Tigner and Stukel 2003).

In Arizona, females are pregnant in April, and maternity colonies have been reported in late April. Indirect evidence (near term embryos and presence of newborns) indicates that the single young is born in June in Arizona. Dates of birth vary considerably throughout the bat's range (from late April to mid-July). In Arizona, most young are flying by the end of July, and nursery colonies begin to disperse during August (Hinman and Snow 2003).

Banding studies indicate high roost and group fidelity and colonies will, if undisturbed, use the same site indefinitely. Most, if not all, females return to their natal group each breeding season resulting in multi-generational, matrilineal colonies. Banded females have been found to remain within a few kilometers of their natal site and when foraging or shifting between alternate roost sites, movement is confined to within 15 kilometers of the primary roost. Even when disbanding from summer colonies to winter hibernacula, banded individuals have not been documented to disperse more than 43 kilometers (Pierson and Rainey 1994).

The mortality rate is high for juvenile bats. The average number of yearling females that return to their natal site in the following breeding season is between 38 and 45 percent. In succeeding years, the survival rate rises to around 75 percent (BISON-M 2004b; Pierson and Rainey 1994). Five years is the average age of PTBB within a population. A single banded individual, however, has been documented at more than 21 years old (BISON-M 2004b). Little is known about the causes of mortality in PTBB; however, predation of the bats by house cats, black rats, and ringtails has been observed. Interspecific competition and disease are not considered to significantly impact populations of this species (BISON-M 2004b). Since *P. t. pallescens* is easily disturbed, arousal during winter hibernation could lead to starvation of a bat from the expenditure of 10 to 30 days of fat reserves (BISON-M 2004b).

The species forages by echolocation, capturing insects in flight and sometimes from leaves along forest edges (BISON-M 2004b; Hinman and Snow 2003). Studies of stomach contents from bats in the Southwest have revealed that their diet consists primarily of lepidopterans, with small quantities of Coleoptera, Diptera, Hemiptera, Hymenoptera, Homoptera, Neuroptera, Trichoptera, and Plecoptera (BISON-M 2004b). Small moths, 3 to 10 millimeters (averaging about 6 millimeters), are the primary food of these bats (AGFD 2003b).

The species forages over desertscrub, riparian habitats, wetlands or open water, typically within 15 miles (24 kilometers), and often within 4 to 5 miles (6.6 to 8 kilometers), of the roost sites (AGFD 2003c; Hinman and Snow 2003). However, recent studies by Rick Sherwin and Antoinette Piaggio indicate that *C. townsendii* may travel large distances while foraging, including movements of over 93 miles (150 kilometers) during a single evening (R. Sidner, pers. comm.). Following a late-night peak of activity, they usually go to a night roost. They may forage again in the early morning, as they are reported not to return to their daytime roosts until shortly before sunrise (AGFD 2003b).

HABITAT REQUIREMENTS

In Arizona, summer day roosts include caves and mines in areas of desertscrub, oak woodland, oak/pine woodland, piñon/juniper woodland, and coniferous forest. PTBB prefer to hang from open ceilings at roost sites and do not use cracks or crevices. At maternity roosts, these bats apparently prefer the dim light near the edge of the lighted zone. In Arizona, emergence times and especially return times and patterns probably vary, as they do elsewhere, depending on insect activity and development stage of young. Night roosts are often in abandoned buildings (Hinman and Snow 2003).

In winter, big-eared bats hibernate in cold caves, lava tubes, and mines. Of all North American bats, this species seems to be the most dependent on availability of abandoned or inactive mines for roost sites (BISON-M 2004b). In Arizona, hibernation sites are mostly in upland and mountainous areas, from the vicinity of the Grand Canyon to the southeastern part of the state. Winter roosts generally contain fewer individuals (usually singles or small groups, and in Arizona occasionally as many as 50) than summer roosts. For hibernation, they prefer roost sites where the temperature is 54ºF (12ºC) or less. Such sites may be near entrances or in well-ventilated areas of the roost. The bats may rouse themselves and move to other spots in the roost during the winter in order to be in areas of stable cold temperatures (Hinman and Snow 2003). Roost selection appears to be limited by the temperature within potential sites (BISON-M 2004b).

4.7.3 Baseline Conditions

CITY POPULATION STATUS

According to the AGFD HDMS (AGFD 2003c), there are no known roost sites within the City HCP planning area. Given the low elevations and relatively flat topography of the planning area, there is also little potential for undocumented roost sites to be present, with the possible exception of areas in the far eastern portion of the planning area (Scott Richardson, pers. comm.). In Pima County, this species is known to use Colossal Cave Mountain Park, Tucson Mountain Park, OPCNM, and SNP (County 2000b).

HABITAT IN AND NEAR THE CITY

Two different models have been developed to delineate potential habitat for PTBB:

- The SDCP habitat model, and
- The City HCP habitat model.

SDCP Habitat Model. A habitat model for PTBB was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following six primary variables:

- Hydrology;
- Vegetation;
- Slope;
- Elevation;
- Aspect; and
- Carbonates.

The habitat potential of the categories of each variable was ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high-potential habitat. The six variables were combined to provide an overall habitat potential. Table 4.7-1 shows the specific categories of the variables considered to provide habitat for the PTBB and their habitat potential ratings.

City PTBB Habitat Model. The SDCP suitable PTBB habitat model appeared to be influenced too strongly by the “slope” variable, which resulted in the identification of only small isolated patches of suitable habitat across the City HCP planning area. The City HCP YAC felt that the foraging potential for the bat was more extensive than what had been captured by the SDCP model, and thus proposed an alternative model.

A potential habitat model for PTBB was developed with the input of the City HCP Technical Advisory Committee, in particular, Dr. Linwood Smith. A composite vegetation map developed by the County as part of the SDCP was used to identify areas characterized as Arizona Upland Subdivision of the Sonoran Desertscrub and Semidesert Grassland biomes. To account for disturbance that has removed the natural vegetation cover from areas within Avra Valley, a mask was applied that removed lands that had been

Table 4.7-1. Value Ratings for Characteristics of the Variables Used in the SDCP Pale Townsend's Big-Eared bat Habitat Model

Variable/Category	Value Rating
Hydrology	
Intermittent stream	2
Adjacent habitat within ½ mile of intermittent stream	2
Adjacent habitat within 1 mile of intermittent stream	2
Perennial stream	2
Adjacent habitat within ½ mile of perennial stream	1
Adjacent habitat within 1 mile of perennial stream	1
Spring	2
Adjacent habitat within ½ mile of spring	2
Vegetation	
Rocky Mountain Montane Conifer Forest Douglas fir-White fir (122.31)	2
Rocky Mountain Montane Conifer Forest Pine (122.32)	2
Rocky Mountain Montane Conifer Forest Xeroriparian biome (122.30XR)	2
Great Basin Conifer Woodland Piñon-Juniper (122.41)	2
Madrean Montane Conifer Forest Douglas fir-Mixed Conifer (122.61)	2
Madrean Montane Conifer Forest Pine (122.62)	2
Madrean Evergreen Forest and Woodland Encineal (Oak) (123.31)	2
Madrean Evergreen Forest and Woodland Oak-Pine (123.32)	2
Madrean Evergreen Forest and Woodland Xeroriparian biome (123.30)	2
Madrean Evergreen Forest and Woodland Xeroriparian Encineal (Oak) (123.31XR)	2
Relict Conifer Forest and Woodland Xeroriparian biome (123.50XR)	2
Sonoran Riparian Woodland Xeroriparian Mesquite (124.71XR)	1
Scrub-Grassland (Semidesert Grassland) Sacaton-Scrub (143.14)	2
Scrub-Grassland (Semidesert Grassland) Mixed Grass-Scrub (143.15)	2
Scrub-Grassland (Semidesert Grassland) Scrub-Shrub Disclimax (143.16)	2
Scrub-Grassland (Semidesert Grassland) Xeroriparian biome (143.10XR)	2
Scrub-Grassland (Semidesert Grassland) Xeroriparian Scrub-Shrub Disclimax (143.16XR)	2
Scrub-Grassland (Semidesert Grassland) Urban Mixed Grass-Scrub (143.15U)	1
Chihuahuan Desertscrub Creosotebush-Tarbush (153.21)	1
Chihuahuan Desertscrub Mixed Scrub (153.26)	1
Chihuahuan Desertscrub Xeroriparian Creosotebush-Tarbush (153.21XR)	1
Sonoran Desertscrub Creosote-Bursage (154.11)	1
Sonoran Desertscrub Paloverde-Mixed Cacti (154.12)	2
Sonoran Desertscrub Xeroriparian biome (154.10XR)	2
Sonoran Desertscrub Xeroriparian Creosote-Bursage (154.11XR)	2
Sonoran Desertscrub Xeroriparian Paloverde-Mixed Cacti (154.12XR)	2

Table 4.7-1. Value Ratings for Characteristics of the Variables Used in the SDCP Pale Townsend's Big-Eared bat Habitat Model (Continued)

Variable/Category	Value Rating
Vegetation (Continued)	
Sonoran Desertscrub Urban Paloverde-Mixed Cacti (154.12U)	1
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian biome (223.20)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Cottonwood-Willow (223.21)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Mixed Broadleaf (223.22)	2
Sonoran Riparian and Oasis Forests Mesquite (224.52)	1
Sonoran Riparian and Oasis Forests Cottonwood-Willow (224.53)	1
Sonoran Riparian and Oasis Forests Urban Cottonwood-Willow (224.53U)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	2
Sonoran Deciduous Swamp and Riparian Scrub Mixed Scrub (234.71)	2
Sonoran Deciduous Swamp and Riparian Scrub Saltcedar Disclimax (234.72)	2
Sonoran Deciduous Swamp and Riparian Scrub Urban biome (234.70U)	2
Active Agriculture (999.11)	2
Urban—Developed (999.21)	1
Lake (999.31)	2
Mining Pond (999.32)	1
Sewage Pond (999.33)	2
Permanent Stream (999.35)	1
Stock Pond (999.36)	2
Slope	
2%–5%	3
5%–10%	3
10%–15%	3
15%–30%	3
30%–50%	3
> 50%	3
Elevation	
195–400 meters	1
401–600 meters	1
601–800 meters	1
801–1,000 meters	1
1,001–1,200 meters	2
1,201–1,400 meters	2
1,401–1,600 meters	2
1,601–1,800 meters	2
1,801–2,000 meters	2

Table 4.7-1. Value Ratings for Characteristics of the Variables Used in the SDCP Pale Townsend's Big-Eared bat Habitat Model (Continued)

Variable/Category	Value Rating
Elevation (Continued)	
2,001–2,200 meters	2
2,201–2,400 meters	2
2,401–2,600 meters	2
2,601–2,800 meters	2
South	1
Southwest	2
West	2
Northwest	1
Carbonates	
Carbonates	3
Area within 1 mile of carbonates	3
Area within 1 mile of known caves and mines	3

Source: *Recon (2002) Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan*.

recently cultivated and had not recovered their natural vegetation composition (Figure 4.7-2). Based on this model, 2,310 acres (935 ha) of potential PTBB habitat is predicted to occur in the Avra Valley planning area.

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

The level of use and potential importance to PTBB of habitats in the Avra Valley HCP planning area is uncertain. No known roost sites (i.e., mines or caves) are known to occur in the planning area. Several roosts are known outside the Avra Valley HCP planning area, and bats from these roosts could forage in portions of the planning area. Of the known bat roosts, the nearest is Old Mammon Mine in the Slate Mountains, which is more than 15 miles from the planning area. Given the distances this bat may travel while foraging, the entire planning area is within potential foraging distance of several known roosts.

4.7.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

PTBB is believed to have declined in parts of its range. This bat is extremely sensitive to human disturbance, and simple entry into a maternity roost can result in the abandonment of the site (Pierson et al. 1991). Because PTBB feeds heavily on Noctuid moths, which require wetland habitats, a decline in wetland habitats also could be contributing to a decline in the bat population. This bat prefers to feed at the interface between upland and riparian vegetation communities, so impacts to these environments in the Avra Valley HCP planning area could reduce foraging opportunities. See Table 4.7-2 for a complete list and discussion of stressors and threats to PTBB.

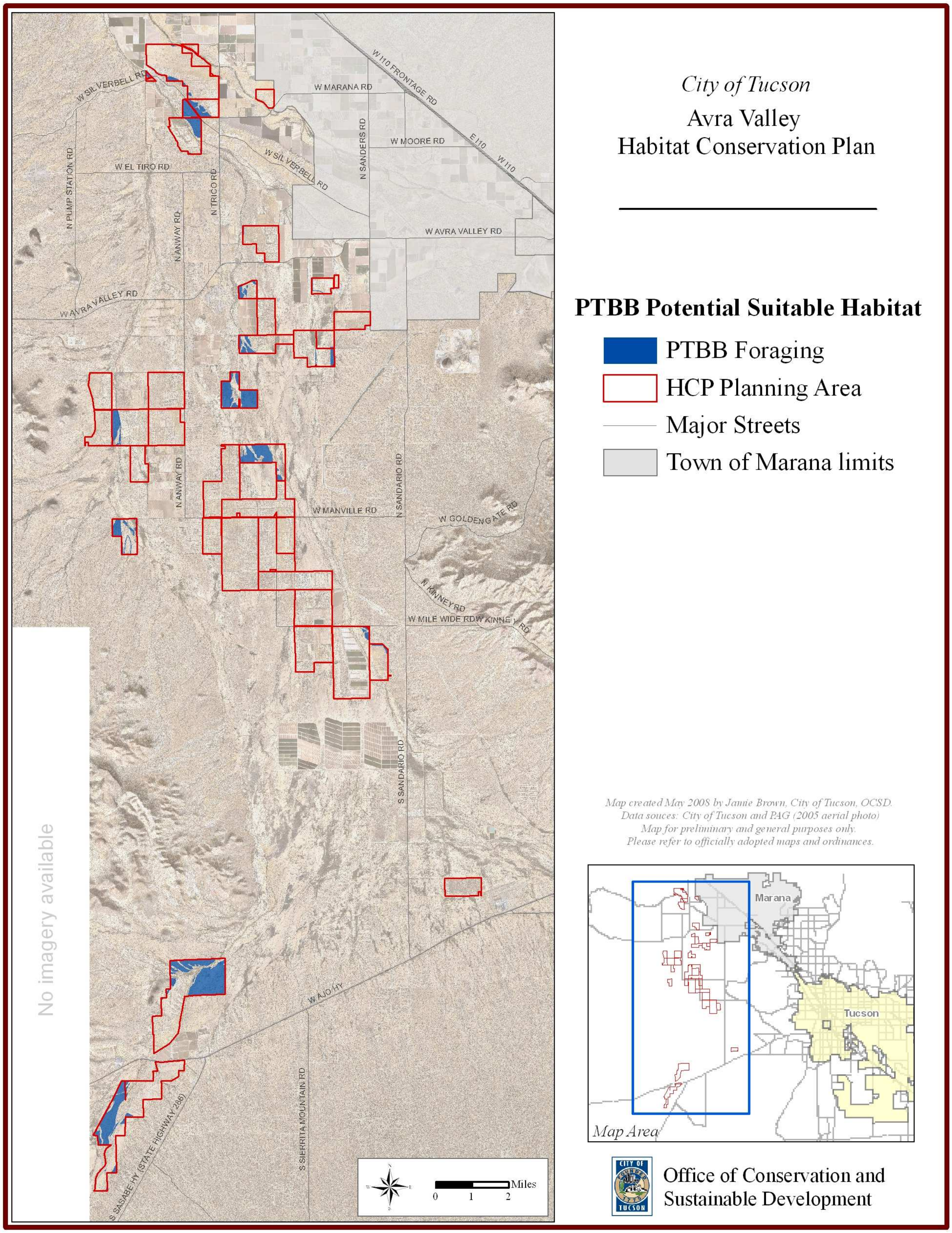

Figure 4.7-2. City of Tucson revised pale Townsend's big-eared bat potential suitable habitat for the HCP Planning Area

Table 4.7-2. Potential and Current Threats and Stressors for Pale Townsend's Big-Eared Bat

Stressor/Threat	Relevance to Species
Habitat Loss	
Foraging	The size of the foraging area is unknown, but this bat apparently will forage over large distances. It is thought to prefer habitat "edges," preferably the interface between upland and riparian environments because of the abundance of insects.
Wintering	Winter roosts are generally caves or mines, which in some cases are threatened by closure.
Migratory stops	Roosts are necessary for migrants.
Roost preferences	Caves and mines are extremely important as roosts for this bat. Temporary roosts include bridges, buildings, and possibly drainage culverts.
Habitat Alteration	
Prey	This bat preys primary on moths (3–10 millimeters in length) in the Family Noctuidae. It also eats other insects.
Nest sites	Maternity roosts are critically important to this species.
Contaminants	There is some indication that bats can acquire toxic materials while in roosts and considerable evidence that some bat species can acquire toxic doses of insecticides by consuming contaminated prey.
Water accessibility	This bat drinks water and is known to forage over water. It appears that very small water sources are used; large bodies of water have not been surveyed. This bat could benefit from the presence of vegetation near water.
Edge effects	This bat prefers to forage along edges, specifically at the interface of upland and riparian communities.
Fire threat	Fire may affect the prey base for this species.
Water quality	This bat appears to be broadly tolerant of water quality.
Species Characteristics	
Behavior traits	This bat is sensitive to disturbance at roosts.
Habitat rehabilitation potential	This bat would benefit from habitat rehabilitation that increases prey base. It could also benefit from gating mines and caves.
Fecundity	Fecundity is low (1 young per year) as with most bats.
Off-site mortality—from surrounding land uses	Could be driven from areas by renewed mining, urban expansion, and human disturbance.
Interspecific Factors	
Predation	Although it is not considered likely, this bat may be subject to predation by cats.
Disease	This bat may be affected by rabies; other diseases are unknown.
Competition	Although this species has been found in roosts with other species, the level of competition with other bats is unknown.
Anthropogenic Factors	
Off-road vehicles	ORVs may be a problem because they provide access to isolated roost sites and may result in disturbance.
Mining	Renewed mining in areas with old mines may result in disturbance or loss of active or potential roosts.
Passive recreation	Passive recreation can result in disturbance to roosts; hiking trails should be routed to avoid roosts.
Grazing	Grazing may affect the prey base of this species, particularly when it occurs in the upland/riparian interface.
Collection/hunting	Not thought to be a problem.
Pesticides—impacts to prey	Pesticides may represent a significant problem for this species, especially to the extent that they affect the prey base.
Direct take/mortality	Direct take of this bat is thought to be limited, except from mine hazard abatement practices, which could have serious impacts. Road paving and de-icing also may affect this bat.
Light	Bright lights near roosts may affect this bat.
Domestic/feral animals	Domestic/feral animals may affect bats if they are present in roost sites.
Connectivity	
Traffic volumes	Increased traffic volume would result in higher probability of vehicular collisions with bats.
Corridor width	Buffers along washes would be beneficial by protecting preferred foraging habitat for this bat. Optimum buffer width is unknown.
Riparian/upland connection	Bridges could be improved as bat roosts.

CURRENT MANAGEMENT RECOMMENDATIONS

The *Arizona Bat Conservation Strategic Plan* outlined a number of management strategies for protecting this and other bat species in the state (Hinman and Snow 2003). These recommendations include identifying, protecting, and enhancing key roosting, feeding, and drinking resources for bats and developing education materials to reach important audiences.

Priority actions to accomplish these management goals include:

- Protecting 90 percent of the sites that shelter hibernation populations or maternity colonies that rank within the largest 10 percent of known sites;
- Incorporating bat-friendly bridge and culvert designs into 25 percent of new highway structures that are potential roosts because of macrohabitat features, and retrofitting 25 percent of existing structures with roost potential;
- Identifying and protecting foraging areas for bats near key roost sites;
- Protecting, restoring, maintaining, and monitoring key open-water drinking sites;
- Protecting, restoring, maintaining, and monitoring key flight and migratory corridors;
- Establishing bat education programs in communities located near important bat roosts or other habitats; and
- Developing and implementing conservation and education programs that would educate residents about bats living in urban environments.

Among other management considerations are the following concepts summarized in Michrochiropteran Bats: Global Status Survey and Conservation Action Plan (Hutson et al. 2001) and in the Habitat Conservation Assessment and Conservation Strategy for the Townsend’s Big-Eared Bat (BISON-M 2004b; Recon 2002).

- USGS and other maps often include cave locations and are freely distributed to civic groups, the media, and the general public. In concert with improved and increased road access, this has made many potential bat caves easily accessible to the general public, thus increasing site visitation and potential harassment.
- Many potential roost sites are located on public lands, and the land management agencies encourage various recreational uses of their holdings. Recreational caving, and hiking, camping, and other activities occurring near potential roosts can result in levels of disturbance that limit or prevent use of the sites by bats. Cavers or other recreational community members may also be hesitant to report locations of bats for fear that the sites may be closed to future recreational use. Visitor access to hibernacula and maternity colonies should be prohibited during critical times of the year.
- Paleontological and archeological sites, which are fairly common in caves in the Southwest, are sometimes protected by the installation of gates or other barriers. These gates can result in sites becoming inaccessible or unsuitable for bats. Similar impacts arise from closures of inactive mine shafts and adits or improper design or installation of bat-friendly gates.
- The presence of mining-associated ponds, often containing toxic concentrations of metals or other chemicals, near potential roosts can create significant consequences for bats. This is of particular concern in desert areas, where mining ponds may be the only available water source near a roost site.

- Heavy use of non-target insecticides can significantly reduce populations of moths, which are a staple in the species' diet, and therefore lead to significant reductions in food availability.
  In addition, because of its entirely insectivorous diet and high rate of food intake, high metabolic rates, and high rates of fat mobilization during migration, hibernation, and lactation, this species may be susceptible to direct poisoning as a result of insecticide application.
- Livestock grazing and other land use activities have resulted in the conversion of riparian habitats into xeric upland habitats. Data on the species indicates a preference for foraging along edge environments between riparian and upland areas. As riparian habitats are lost, these edge areas disappear. Riparian habitats within 10 miles of roosts sites should be improved and maintained.
- Changes in plant density and composition in areas of potential foraging habitat may result in a reduction in the plant species necessary to support moth populations. Given its preference for moths, these changes can significantly impact the prey base for the Townsend's big-eared bat.

4.7.5 Potential Impacts of the City's Proposed Activities

DIRECT EFFECTS

PTBB require caves or mines as hibernacula and maternity roosts. No known roost sites occur in the Avra Valley HCP planning area, and no suitable roost sites are expected to occur in areas of possible future water supply and capital improvement projects. Therefore, take of bats resulting from destruction of roosts during construction activities is not anticipated.

INDIRECT EFFECTS

Indirect effects from land development include noise, and other construction-related disturbance that could cause individual bats to move to other foraging areas, potentially increasing the energetic demands of bats. However, since these bats forage at night or at dawn when construction activities typically are not being conducted, there is little potential for these types of effects. Further, PTBB have not been documented within the Avra Valley HCP planning area, and given the distance of the planning area from all but one of the known roosts, the planning area is probably not heavily used by this species.

POTENTIAL HABITAT CHANGES

Impacts to Potential PTBB Habitat in the Avra Valley Planning Area

As proposed in the City Water Plan, planned water supply and capital improvement projects could directly impact all suitable PTBB habitat in the Avra Valley planning area. Given the uncertainty in the Plan regarding the types and scope of projects that may be constructed within the planning area, we are assuming a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside of the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in fragmentation of the remaining habitat within these properties. Without knowing the final location and design of any of these facilities, we cannot say that any habitat in Avra Valley will not be impacted in some fashion by these covered activities.

The nearest known roosts of this bat are more than 15 miles (24 kilometers) from the Avra Valley planning area. Although PTBB is capable of foraging flights in excess of 90 miles, the majority of flights are likely much shorter (less than 15 miles), and the extent of use of habitats in the Avra Valley HCP planning area for foraging is probably low. As a result, a reduction in the amount of potential foraging habitat in the Avra Valley HCP planning area is not likely to substantially reduce foraging opportunities for this species.

POPULATION-LEVEL EFFECTS

PTBB are not likely to be directly affected by planned water supply and capital improvement projects in the Avra Valley HCP planning area. The SDCP habitat model predicts that Pima County supports about 1.3 million acres of high potential habitat. Given the relatively low level of use of foraging habitat predicted in the Avra Valley HCP planning area and the abundance of potential habitat elsewhere in Pima County, reductions in potential foraging habitat for PTBB in the Avra Valley HCP planning area would not be expected to affect the population viability of this species.

4.8 Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*)

4.8.1 Population Distribution, Taxonomy, and Status

RANGE AND DISTRIBUTION

Two subspecies of the yellow-billed cuckoo are currently recognized in North America by the American Ornithologists' Union (AOU 1957), one in the east and one in the west**.** Western yellow-billed cuckoo (*Coccyzus americanus occidentalis)*, the only subspecies of yellow-billed cuckoo that occurs in Arizona, was formerly widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, common very locally in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and very local in British Columbia (USFWS 2001). Currently, Western yellow-billed cuckoo (WYBC) is known to breed in California, Arizona, New Mexico, extreme western Texas, Sonora, Chihuahua, and south irregularly to Zacatecas, Mexico (Howell and Webb 1995; Hughes 1999; Russell and Monson 1998). It winters in north and central South America east of the Andes (Hughes 1999).

In Arizona, WYBC nests primarily in the southern and central portions of the state (Figure 4.8-1) (AGFD 2002; Recon 2002). It has been extirpated from most lower-elevation localities, especially the Colorado River valley (AGFD 2002) and most of the Santa Cruz River in Pima County (Corman and Magill 2000). WYBC was documented along 25 drainages in Arizona in 1998 and 1999, with the major concentrations occurring along the Agua Fria, San Pedro, and Verde rivers, and the Cienega and Sonoita creeks (Corman and Magill 2000).

TAXONOMIC DISTINCTNESS

The taxonomic distinctness of Western and Eastern yellow-billed cuckoos remains in question.
It should be noted that there are no universally accepted criteria for differentiating subspecies of birds (or anything else), and that taxonomy at this level is a rapidly evolving science.

Ridgway named two subspecies in 1887 based on morphological measurements of a small number of individuals, and accepted as valid in the American Ornithologists Union 1957 Checklist of North American Birds (AOU 1957). In subsequent editions of the checklist, the AOU has not used subspecies names because the authors considered it necessary to review and evaluate the subspecific taxonomic status of North American birds. Recognition of subspecies was questioned or rejected by several authors over a period of decades, largely because morphological differences appear to be very slight and not

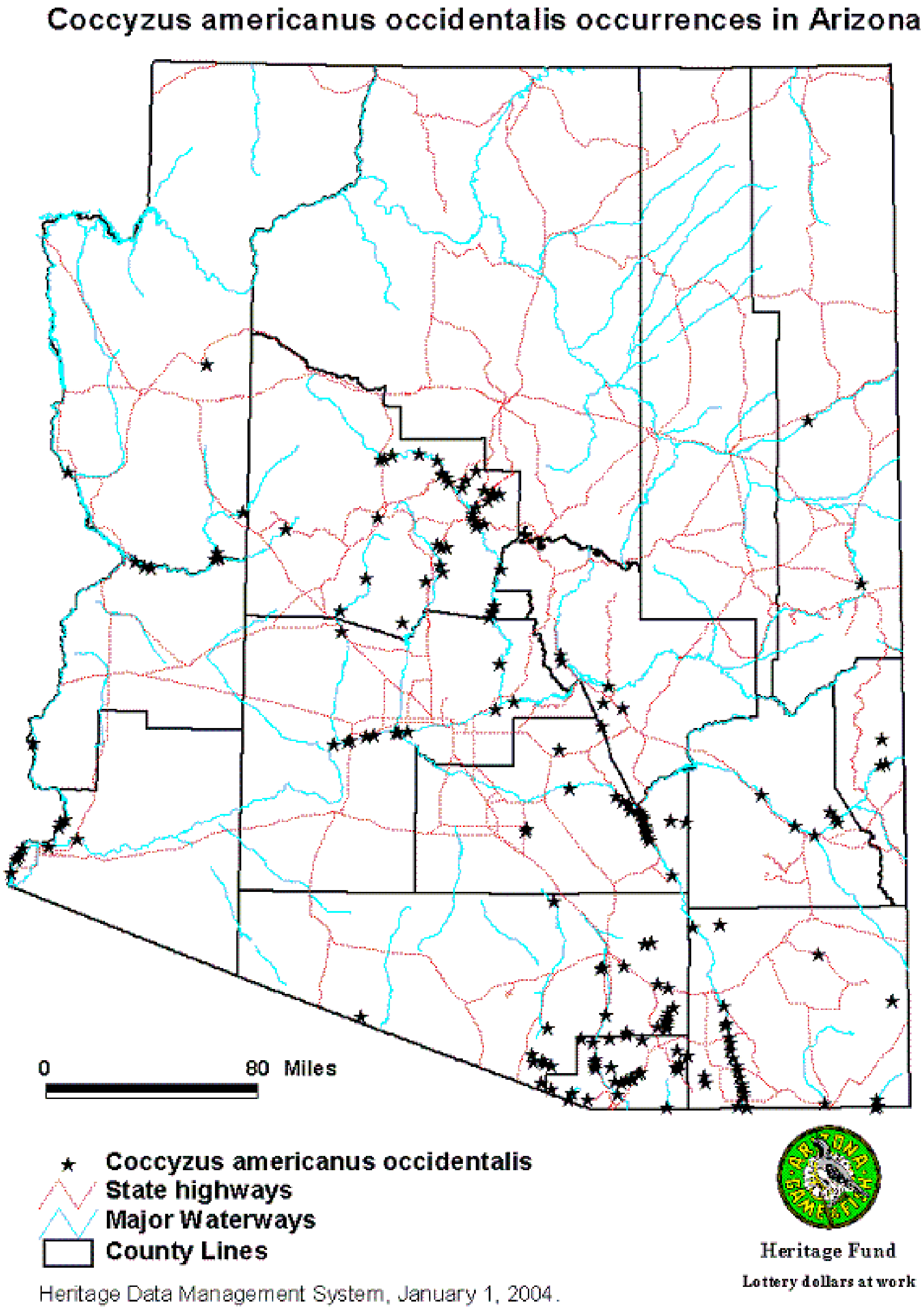

Figure 4.8-1. Historical distribution map of Western yellow-billed cuckoo in Arizona based on locations reported in the AGFD HDMS. Source: AGFD.

statistically significant (Laymon 2000). Franzreb and Laymon (1993) concluded that the two subspecies should be retained based on the morphological, behavioral, and ecological differences between Western and Eastern birds. Laymon (2000) reviewed dissenting opinions and concluded that a complete, modern

study of geographic variation in the species should be conducted to evaluate the taxonomic status. However, he emphatically concluded that the Western birds represent a DPS separate from the Eastern birds based on several behavioral aspects of their biology (Laymon and Halterman 1987). The AOU Committee on Classification and Nomenclature, at the request of the USFWS, reviewed the taxonomic validity of the subspecies and concluded that the species should be considered monotypic, without subspecies, because the differences between the populations were too small to support separation as subspecies (USFWS 2001).

Genetic analysis has so far been inconclusive, at least in part because standards for recognizing subspecies have not been established. In one recent analysis of mitochondrial DNA (mtDNA) variation in yellow-billed cuckoos across their historical range, the hypothesis that Western U.S. populations are a separate subspecies or evolutionarily significant unit (ESU) from Eastern U.S. populations was not supported (Fleischer 2001). Nevertheless, Fleischer concedes, based on a significant divergence in haplotype frequencies between cuckoos from the two regions, that Eastern and Western regions might be separated as Management Units (MUs). Another genetic study published at essentially the same time (Pruett et al 2001) concluded that the evidence supports continued separation of the two subspecies and recognition of the Western subspecies as an ESU.

POPULATION STATUS AND THREATS

Federal Status. The USFWS considers the Western population of yellow-billed cuckoo a DPS based on the physical, ecological, and behavioral discreteness of the population segment and determined that listing this DPS as threatened is warranted but precluded by higher-priority listing actions (USFWS 2001).

Range-Wide Population Status and Threats. Like many riparian obligate species, the breeding distribution and number of WYBC has declined in the past 80 years throughout Western North America (AGFD 2002). It disappeared from British Columbia in the 1920s, from Washington in the 1930s, from Oregon in the 1940s, and from northernmost California in the 1950s. It is extremely rare in the interior West. The only remaining Western “strongholds” are three small populations in California, scattered populations in Arizona (especially on the San Pedro River) and New Mexico (especially the Gila River), and an unknown number of birds in northern Mexico (BISON-M 2004b). The species was listed by the State of California as threatened in 1971 and was reclassified as endangered in 1987. It is ranked as critically imperiled in Washington, and in Nevada the yellow-billed cuckoo is listed as State Rank S1 Nevada State Protected, meaning that the species is protected within the state and is considered critically imperiled due to extreme rarity, imminent threats, and/or biological factors.

Arizona Population Status and Threats. Arizona probably contains the largest remaining WYBC population among states west of the Rocky Mountains and is therefore considered critically important, since breeding populations throughout the West have been extirpated or greatly reduced (Recon 2002; USFWS 2001). In a 1998/1999 study (Corman and Magill 2000), WYBC were detected along 25 main drainages in Arizona, with the major concentrations occurring along the Agua Fria, San Pedro, and Verde rivers, and the Cienega and Sonoita creeks. It is considered a Species of Special Concern within the state because it has been extirpated from most Lower Sonoran localities, especially the Colorado River valley, by unmitigated destruction of riparian gallery forests (AGFD 2002). Loss of mature cottonwood-willow riparian habitat through degradation, modification, and fragmentation is the primary threat to the remaining populations of yellow-billed cuckoos in central and southern Arizona (AGFD 2002; Recon 2002). Major threats to this habitat include:

- Reclamation, flood control, and irrigation projects;
- Urbanization and agricultural activities;
- Invasion of non-native salt cedar into riparian areas; and
- Livestock grazing and ORV use within riparian habitats.

4.8.2 Ecology

LIFE HISTORY

WYBC is a member of the avian family Cuculidae (cuckoos and roadrunners) in the order Cuculiformes, members of which share the common feature of a zygodactyl foot, in which two toes point forwards and two toes point backwards. Of the six species of Cuculidae that breed in the U.S., two species, WYBC and the greater roadrunner, breed west of the Continental Divide (USFWS 2001).

WYBC arrives on the breeding grounds beginning in mid- to late May, initiating nesting activity in early to mid-June (southern California), through August, and frequently into September (southeastern Arizona) (Corman and Magill 2000). Nesting peaks in mid-July and early August. Breeding may be triggered by an abundance of insects or other large prey, which form the bulk of the species' diet (AGFD 2002; Recon 2002). Populations fluctuate substantially in response to fluctuations in caterpillar abundance (BISON-M 2004b). Prey abundance may lead to the production of excess eggs and thus to brood parasitism, where the cuckoo's excess eggs are laid in other birds' nests (Recon 2002).

Both male and female yellow-billed cuckoos build the nest, generally from 4 to 30 feet (1.2 to 9.1 meters) above the ground, often in willow or mesquite thickets (AGFD 2002). West of the Continental Divide, nesting occurs almost exclusively close to water, and biologists have hypothesized that the species may be restricted to nesting in moist river bottoms in the West because of humidity requirements for successful hatching and rearing of young (Rosenberg et al. 1991). The nest is well concealed by the surrounding foliage, and consists of an unkempt stick platform, thinly lined with leaves, mesquite, and cottonwood strips, grass, and catkins, with a depression to hold the eggs (AGFD 2002; Ehrlich et al. 1988). The clutch size is usually two or three eggs, and the development of the young is very rapid, with a breeding cycle of 17 days from egg laying to fledging of young (USFWS 2001). The male feeds the early fledglings, while the female feeds the late fledglings (Ehrlich et al. 1988).

HABITAT REQUIREMENTS

WYBC appears to require large blocks of riparian habitat for nesting, particularly woodlands with Fremont cottonwoods and Goodding willows (USFWS 2001). In Arizona, the species occurs from 90 to 6,710 feet (27–2,045 meters) above mean sea level, preferring streamside cottonwood/willow groves and larger mesquite bosques for migrating and breeding. It is rarely observed as a transient in xeric desert or urban settings (AGFD 2002). Rosenberg et al. (1991) speculated that in the Lower Colorado River Valley, mature cottonwoods, with willows forming a sub-canopy layer, provide the best shade of any riparian habitat against the extremely high midsummer temperatures; salt cedar and open mesquite bosques are inadequate in buffering lethal temperatures. In addition, standing water in many cottonwood-willow groves may help to lower air temperature by evaporative cooling; thus, the decline in cuckoo populations may be attributed largely to the removal of necessary thermal cover (Rosenberg et al. 1991).

WYBC has been found in mature Sonoran Riparian Deciduous Forest, Cottonwood-Willow Series, and Sonoran Riparian Scrub in well-developed mesquite bosques (Corman and Magill 2000). Areas in which cuckoos have been found in recent years were at least 37 acres in size and included 7 acres or more of closed canopy, with canopy heights of 16 to 100 feet (5–30 meters) and understory heights of 3 to 20 feet

(1–6 meters) (Hughes 1999). Of the six active cuckoo nests found in Arizona during the 1998 and 1999 seasons, one was found in Arizona alder (*Alnus oblongifolia*), one in salt cedar, two in Fremont cottonwood, and two in Goodding willow (Corman and Magill 2000).

Caterpillars form the main component of the diet of WYBC, with cicadas, grasshoppers, birds' eggs, frogs, lizards, ants, beetles, wasps, flies, and fruit being consumed in smaller amounts (Ehrlich et al. 1988; Howe 1986; Hughes 1999).

WYBC may be found in less than optimal habitat during migration. Even though such habitats do not support breeding, they are definitely important for survival of the species (Magill and Halterman 1999). Potentially suitable migration habitat includes areas of Sonoran Riparian Deciduous Forest, Cottonwood-Willow Series and Sonoran Riparian Scrub with large mesquites that are less well developed than those in breeding habitat. No minimum size for suitable migration habitat has been determined, and it is possible that only a few trees would be sufficient for migrating birds (T. Corman, AGFD, pers. comm.). Most recent records of the cuckoo from sites along the effluent-dominated reach of the lower Santa Cruz River and Tanque Verde Creek are thought to be unpaired birds (Sage 2003), but records at the Simpson Farm North property during 2005 suggest that nesting may occur at this location (see below).

4.8.3 Baseline Conditions

CITY OF TUCSON POPULATION STATUS

The Avra Valley HCP planning area provides some migratory stopover habitat for WYBC. Although WYBC may nest in small numbers in broadleaf riparian habitat along the Avra Valley planning area at the Simpson North property, nesting has not yet been confirmed. In July 2005, Scott Wilbor of the Audubon Society detected yellow-billed cuckoo(s) during avian point count surveys along a 2,380-meter stretch of the Santa Cruz River at Simpson Farm North. The Simpson property is being managed by Tucson Audubon Society for habitat restoration, and has some well-developed cottonwood-willow vegetation. On July 14, 2005, Wilbor detected at least two cuckoos along the same survey route. Although cuckoos were detected at more than one location along the transect route, it is possible that some of the detections were of the same individual(s) following Wilbur as he moved west along the transect. On July 22, 2005, Kendall and June Kroesen of Tucson Audubon conducted another avian point count survey at the Simpson Farm property. They detected one cuckoo at several points along the survey route. As a result of Tucson Audubon Society's findings and at the request of the City HCP Technical Advisory Committee, Scott Blackman and Cathy Crawford of AGFD Research Branch conducted a call-playback survey for the cuckoo at the Simpson Property on July 29, 2005, and heard one cuckoo. AGFD biologists concluded that it is possible that this cuckoo might have been nesting on the Simpson Farm property based on the fact that it was still in the area fairly late in the breeding season. Blackman and Crawford returned to the Simpson Farm property on August 19, 2005, and conducted another call-playback survey, but no cuckoos were detected. In conclusion, neither the Tucson Audubon Society nor the AGFD were able to verify yellow-billed cuckoo nesting on the Simpson Farm property (AGFD 2005).

Within the region, WYBC are known to be present along Cienega Creek, in Cienega Creek County Park, immediately upstream from the dam and at intervals upstream from the road bridge along the wet reaches of the creek. Although no nests or young birds were located, frequent calling during breeding season and persistence in June and July suggest that cuckoos may be breeding there (K. Kingsley, personal observations, 2004). Cuckoos were found during post-breeding season surveys conducted in 2002 along the effluent-dominated reach of the Santa Cruz River and Tanque Verde Creek (Sage 2003). Cuckoos were known to be present in abundance in the pecan orchards in Green Valley, along the Santa Cruz River south of Tucson in the late 1980s (Kingsley 1989). Other nearby records are from the Santa Cruz River near San Xavier Mission and along Tanque Verde Wash in the Rincon Mountains.

HABITAT IN AND NEAR THE PLANNING AREA

Two different models have been developed to delineate potential habitat for the yellow-billed cuckoo:

- The SDCP habitat model; and
- The City HCP cuckoo habitat model.

SDCP Habitat Model. A habitat model for the yellow-billed cuckoo was developed as part of the SDCP (Recon 2002). This habitat model consisted of the following five primary variables:

- Hydrology;
- Vegetation;
- Slope;
- Elevation; and
- Landform.

The habitat potential of the categories of each variable was ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high-potential habitat. The five variables were combined to provide an overall habitat potential. Table 4.8-1 shows the specific categories of the variables considered to provide habitat for the yellow-billed cuckoo and their habitat potential ratings. Using this habitat model, the Avra Valley HCP planning area supports about 11,298 acres of high-potential habitat and 7,421 acres of medium-potential habitat for yellow-billed cuckoo.

Table 4.8-1. Value Ratings for Characteristics of the Variables Used in the SDCP Western Yellow-billed Cuckoo Habitat Model

Variable/Category	Value Rating
Hydrology	
Intermittent stream	2
Adjacent habitat within 0.5 mile of intermittent stream	1
Perennial stream	2
Vegetation	
Sonoran Riparian Woodland Xeroriparian mesquite (124.7)	3
Scrub-Grassland Mixed grass-scrub (143.15)	1
Scrub-Grassland Xeroriparian biome (143.10.XR)	1
Sonoran Desertscrub Upland Paloverde-mixed cacti (154.12)	3
Sonoran Desertscrub Xeroriparian Paloverde-mixed cacti (154.12XR)	3
Sonoran Desertscrub Urban Paloverde-mixed cacti (154.12U)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian biome (223.20)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian cottonwood-willow (223.21)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian mixed broadleaf (223.22)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Urban biome (223.20U)	2
Sonoran Riparian and Oasis Forests Meso-riparian mesquite (224.52)	3

Table 4.8-1. Value Ratings for Characteristics of the Variables Used in the SDCP Western Yellow-billed Cuckoo Habitat Model (Continued)

Variable/Category	Value Rating
Vegetation (Continued)	
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53)	3
Sonoran Riparian and Oasis Forests Urban mesquite (224.52U)	2
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53U)	2
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian mixed scrub (234.71)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian saltcedar disclimax (234.72)	1
Slope	
0%–2%	1
2%–5%	1
Elevation	
195–400 meters	1
401–600 meters	2
601–800 meters	2
801–1,000 meters	2
1,001–1,200 meters	2
Land Form	
Drainageways	2
Floodplains	2
Terraces	2

Source: Recon (2002) *Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan.*

City WYBC Habitat Model. The SDCP suitable WYBC habitat model was heavily influenced by the floodplain "landform" variable, with historical floodplain areas along the Santa Cruz River being mapped as suitable cuckoo habitat in this model. Although the floodplain would have historically been the location of suitable riparian habitat for this species, specifically cottonwood-willow gallery forests and to some extent mature mesquite bosques, the Santa Cruz River has become entrenched through the City and the channel has become isolated from the historic floodplain, in many areas by 10 to 15 vertical feet (3.1–4.5 meters), preventing the floodplain from supporting riparian-obligate cottonwood and willow species. The City HCP Technical Advisory Committee supported the development of an alternate model, which focused on densely-vegetated, riparian ecosystems, rather than on the disconnected floodplain. The low-flow channel, i.e., the sandy river bottom, does not currently support suitable cuckoo habitat, except perhaps in a few isolated patches; however, the model recognizes the dynamic nature of riparian systems and includes areas that may become potential habitat for the cuckoo in addition to any areas that may currently provide habitat. To capture the potential for riparian systems to evolve over time, including shifts in the location of patches of riparian habitat, the mapped floodway was used as the basis for modeled potential habitat along the Santa Cruz River.

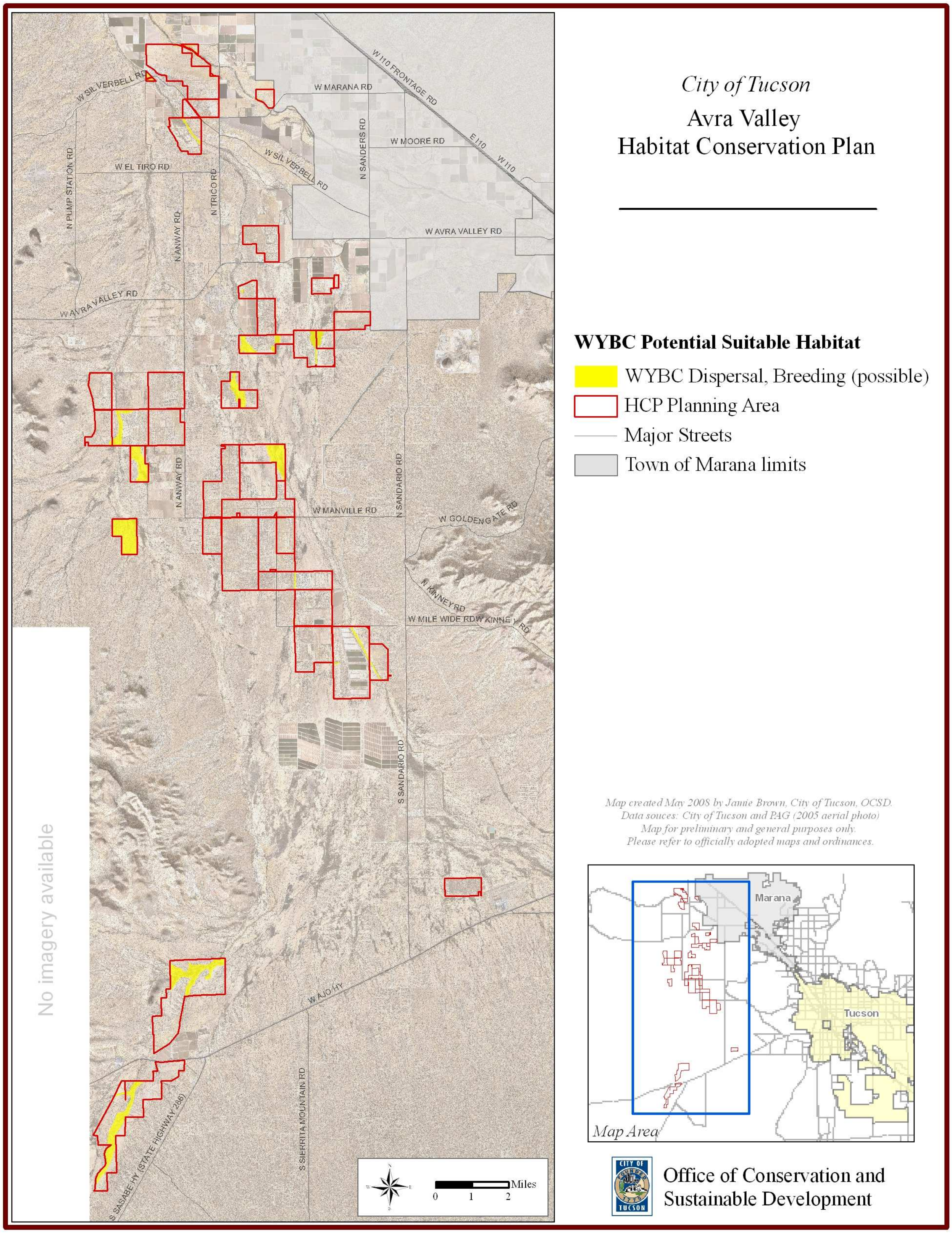

Figure 4.8-2. Habitat potential for Western yellow-billed cuckoo

There are no documented cases of WYBC breeding in the Tucson area, and based on the current understanding of the cuckoo's habitat preferences, it is fairly certain that no potential breeding habitat currently exists within the Avra Valley HCP planning area. All of the cuckoos reported in and around the planning area are assumed to be migratory, using existing riparian patches as stopover habitat as they pass through the area. Although a number of proposed river restoration projects may result in the creation of potential breeding habitat within the Avra Valley HCP planning area, natural conditions are not likely to produce any riparian areas of sufficient size and structure to support breeding birds. Limited water availability also makes it unlikely that any significant stands of high suitability breeding habitat can be restored as part of the river restoration; however, habitat within the planning area may be used both for cuckoo dispersal and, possibly, breeding. Based on this habitat model, 2,097 acres of potential dispersal and possible breeding habitat is predicted to occur in the Avra Valley planning area (see Figure 4.8-2). This is the same potential habitat as both LLNB foraging and CFPO over-wintering habitats,

IMPORTANCE OF THE PLANNING AREA IN SPECIES' RANGE AND ECOLOGY

WYBC have been documented within the City HCP planning area during migration (probably throughout the Santa Cruz River corridor) and during the breeding season (Simpson Farm North). Recent records at Simpson Farm North suggest that some riparian habitats in the Avra Valley planning area may provide potential breeding as well as migratory stopover habitat for cuckoos (AGFD 2005). The riparian and wetland habitat of the Santa Cruz River is sustained by effluent discharges from the Rogers Road and Ina Road Wastewater Treatment Plants. While the effluent provides a consistent source of water in portions of the river, the habitat along the river is strongly influenced by the interaction of flooding frequency and intensity, variation in infiltration rates, and the amount of regional groundwater pumping, resulting in the spatial and temporal variability of suitable WYBC habitat (CH2MHill 2003).

4.8.4 Threats and Management Needs

POTENTIAL THREATS AND STRESSORS

Loss of mature cottonwood-willow riparian habitat is the primary threat to the remaining populations of yellow-billed cuckoo in southern Arizona. Major threats to this habitat include: 1) reclamation; flood control, and irrigation projects; 2) urbanization and agricultural activities; 3) Invasion of non-native salt cedar into riparian areas; and 4) livestock grazing and ORV use within riparian habitats.

Excessive noise and movement of people through riparian areas may affect nesting cuckoos. Although cars occasionally hit cuckoos, collisions are probably not a major source of cuckoo mortality, except perhaps in the vicinity of bridges. There is little or no information on susceptibility to diseases, and limited information on population biology. See Table 4.8-2 for a complete list and discussion of stressors and threats to yellow-billed cuckoo.

Table 4.8-2. Potential and Current Threats and Stressors for Western Yellow-Billed Cuckoo

Stressor/Threat	Relevance to Species
Habitat Loss	
Breeding	Yellow-billed cuckoo breeds in large blocks of dense riparian vegetation with tall trees and a well developed mid-story. High humidity and shade apparently are necessary for cooling eggs. Loss of riparian habitat and removal of thermal cover are thought to be the primary threat to this species.
Dispersal	Dispersal habitat is unknown, but cuckoos probably follow river courses. Two potential corridors have been identified for the City HCP planning area: the Santa Cruz River and the Brawley Wash system in Avra Valley (as an extension of the Altar Wash).
Foraging	The size of the foraging area is unknown, but cuckoos generally forage on large insects in trees.
Wintering	This species winters in South America.
Migratory stops	Migratory stops are generally in large trees or in dense clusters of smaller trees.
Habitat Alteration	
Prey	The principal prey of this species is large insects usually found in trees, including caterpillars, cicadas, grasshoppers, and katydids. Consequently, the loss of trees in the riparian setting results in the loss of prey diversity and abundance.
Nest sites	Dense riparian vegetation with well-developed mid-story and canopy layers and high humidity are necessary components of nesting habitat for this species.
Vegetation composition/density	The maintenance of a high density of riparian vegetation at different stages of growth is important to this species.
Habitat conversion	Fire and projects that result in water withdrawal and/or water diversion can result in adverse impacts to yellow-billed cuckoo habitat.
Escape cover	Cuckoos require cover, not only for thermal regulation, but also for escape and protection from raptors.
Fragmentation	Although cuckoos prefer large, continuous blocks of vegetation, they can use isolated patches. However, extensive fragmentation of riparian vegetation patches interspersed with open non-vegetated areas is probably not as beneficial as large, continuous blocks of habitat. Minimum patch size and maximum distance between patches are not known.
Invasive plant species	Cuckoos are known to nest and roost in tamarisk, but patches of tamarisk alone do not provide adequate thermal cover.
Habitat rehabilitation potential	The rehabilitation of cuckoo habitat, especially for migratory stops, is considered a useful mitigation strategy. However, the cost and resources available for creating suitable breeding habitat may be prohibitive.
Contaminants	The effect of contaminants on cuckoos is unknown, although some concern has been expressed about pesticide drift in California.
Water accessibility	Cuckoos drink water and forage near water; even very small water sources may be used. As discussed previously, cuckoos benefit from the high humidity associated with dense vegetation around water.
Drought	Drought, especially long-term, may result in loss of riparian habitat and reduction in prey populations.
Flood	Natural flooding is necessary for regeneration of riparian habitat; however, catastrophic flooding and flood control result in loss of habitat and failure to regenerate.
Groundwater depletion	Groundwater depletion results in loss of riparian habitat.
Edge effects	Edges are not considered beneficial for this species; this bird prefers large blocks of habitat.
Water quality	Broadly tolerant of water quality.
Behavior traits	Cuckoos are difficult to detect except during nesting season using playback calls, and during nesting they are present in a specific area for only a very brief period of time.

Table 4.8-2. Potential and Current Threats and Stressors for Western Yellow-Billed Cuckoo (Continued)

Stressor/Threat	Relevance to Species
Habitat Alteration (Continued)	
Habitat rehabilitation potential	Potential habitat rehabilitation may best be accomplished by using resources to create suitable migratory stops.
Colonization potential	Cuckoos are known to be able to locate isolated areas of suitable habitat.
Breadth of resource use	Cuckoos use a diverse and relatively abundant prey base. More critical to cuckoos are nesting and roosting habitat, which are uncommon and declining.
Interspecific Factors	
Predation	Cuckoos may be susceptible to predation by raptors, but this is not considered a major population-limiting factor.
Disease	This species is susceptible to West Nile Virus and is known to reside in areas of high mosquito density; however, the effect of the virus on populations is unknown at present. Whether other diseases affect cuckoos is unknown.
Domestic/feral animals	Predation by cats is not considered a problem for this species.
Invasive species	Although currently unknown, invasive species are not considered a problem for cuckoos.
Anthropogenic Factors	
Edge effect	This bird prefers large blocks of vegetation, so it does not benefit from edge effects.
Fire threat	Fires can destroy riparian habitat for cuckoos.
Grazing	Grazing may be a problem if it results in impacts to riparian vegetation or inhibits the growth of new riparian vegetation.
Collection/hunting	The scientific collection and hunting of cuckoos is not considered a problem.
Pesticides	Pesticides may reduce the prey base of cuckoos, but this has not been scientifically demonstrated.
Direct take/mortality	Direct take/mortality of cuckoos is not considered a problem.
Noise	Excessive noise may cause abandonment of nests during the early breeding season.
Movement	Movement of people through riparian zones may be problem, depending on frequency and duration.
Landscaping	Landscaping with native plants could provide opportunities for habitat improvement, especially if landscaping results in an increase in populations of large insects that are this bird's prey base.
Invasives	Tamarisk control may be harmful if plants are not replaced with native vegetation.
Domestic/feral animals	Domestic/feral animals are not considered a problem for cuckoos.
Automobile collisions	Although cars occasionally hit cuckoos, vehicular collisions are probably not a major problem, except perhaps in the vicinity of bridges.
Connectivity	
Fragmentation	Although cuckoos prefer large, continuous blocks of vegetation, they can use isolated patches. However, extensive fragmentation of riparian vegetation patches interspersed with open non-vegetated areas is probably not as beneficial as large, continuous blocks of habitat. Minimum patch size and maximum distance between patches are not known.
Wash incision	Wash incision is beneficial if it results in the creation of new habitat.
Habitat patchiness	Potential cuckoo habitat consists of large patches of dense riparian vegetation.
Riparian/upland connection	The connection between riparian and upland habitat is not considered a problem, except with regard to maintaining healthy riparian areas.
Road crossings	Bridges at canopy level may increase vehicular collisions.

CURRENT MANAGEMENT RECOMMENDATIONS

Management recommendations for WYBC are based on Laymon and Halterman (1989), Latta et al. (1999), and Wiggins (2005). These recommendations can be broadly summarized as follows:

- Restore riparian woodlands by restoring natural flow regimes to watercourses and by restricting or eliminating livestock grazing in riparian areas.
- Evaluate the use of pesticides in riparian woodlands and nearby areas.
- Census riparian woodlands for before/after effect of any habitat manipulations.

- Monitor reproductive success in managed/unmanaged plots, as well as comparing reproductive success before and after habitat manipulations.

Additional recommendations provided by Arizona Partners in Flight (Latta et al. 1999) build on those listed above by providing more specific management details for cuckoos in Arizona.

Habitat Loss and Modification

- Establish a “no net loss” policy.
- Eliminate destruction (i.e., grazing, ORV use) of existing native cottonwood-willow dominated riparian forests.
- Encourage the use of buffer zones between riparian habitats and adjacent development.
- Establish corridors between “islands” of suitable habitat.
- Manage for large, contiguous blocks of habitat (> 37 acres) in conjunction with removal of competing exotic species (i.e., saltcedar).

Lack of Recruitment (of cottonwood-willow forests)

- Closely monitor grazing impacts on cottonwood and willow seedlings in riparian systems and reduce or remove grazing when seedlings are being impacted.
- Maintain flow regimes that mimic natural level and timing of high and low water to allow accumulation of sediments and subsequent establishment of seedlings.
- Promote natural regeneration from seed sources. Augment with plantings (> 37 acres) when necessary.
- Reduce or eliminate recreational impacts and disturbance to nursery beds during and after seedling establishment.

Pesticide Use

- Limit or eliminate use of pesticides adjacent to riparian areas.
- If used, apply locally to avoid drift into adjacent habitat (i.e., not broad applications).

Demographics (low colonization potential due to fragmented breeding localities)

- Establish riparian corridors and “island” habitats to allow natural dispersal and recolonization of historical habitats.
- Establish target areas near existing occupied habitat for restoration before focusing on areas farther away.

Human Disturbance

- Avoid intense and repeated human disturbance from nesting areas, especially from May 20 through September 1.

Implementation Opportunities

- Increase enforcement of access into restricted areas.
- Increase cooperation between state and federal agencies and private organizations regarding WYBC habitat.

4.8.5 Potential Impacts of the City's Proposed Activities

DIRECT EFFECTS

It is unlikely that construction for any of the proposed covered activities would directly kill or injure WYBC. Within the Avra Valley HCP planning area, cuckoos are most likely to occur in riparian habitats, which are not likely to be directly impacted by construction activities. Further, there are no confirmed cuckoo nesting records within the planning area.

INDIRECT EFFECTS

Short-term construction disturbances, should they occur within WYBC habitat, would include noise, dust, traffic, and other human activities that could result in deterring WYBC from using the area. Habitat impacts also could affect future use of the area by the cuckoo.

POTENTIAL HABITAT CHANGES IN THE CITY

As proposed in the City Water Plan, planned public water infrastructure projects could directly impact all 2,097 acres of suitable cuckoo habitat in the Avra Valley HCP planning area. Given the uncertainty in the City Water Plan regarding the types and scope of projects that may be constructed within the planning area, we are assuming a worst-case scenario. The total footprint of covered activities in Avra Valley, e.g., recharge basins, evaporation ponds, treatment plant, etc., may require almost 7,300 acres. Construction of these projects will create impacts outside the project footprints, long-term disturbance to habitat may result from operation of these facilities, and the covered activities may, depending on their location and configuration, result in degradation of the remaining habitat within these properties. Without knowing the final location and design of any of these facilities, we cannot say that any cuckoo habitat in Avra Valley will not be impacted in some fashion by these covered activities.

POPULATION-LEVEL EFFECTS

Development could result in a small reduction in potential WYBC habitat in the Avra Valley HCP planning area. However, distribution of breeding cuckoos in the planning area is poorly understood, and numbers of breeding cuckoos are likely small, if cuckoos breed at all.

The level of use of habitats in the City by migratory cuckoos also is unclear. If City properties are used by cuckoos during migration from within and outside of Arizona, then reductions and/or modifications of habitat from changes in effluent availability or restoration projects could contribute to reductions in cuckoo populations elsewhere. While it is possible that future impacts (particularly reductions in effluent water released into the Santa Cruz River) could occur, the number of cuckoos affected and the impact on local and regional populations is unclear.

Section 5

CONSERVATION PROGRAM

5.1 Introduction

The City of Tucson is covering seven species in this HCP:

- Lesser long-nosed bat;
- Cactus ferruginous pygmy-owl;
- Western burrowing owl;
- Tucson shovel-nosed snake;
- Ground snake (valley form);
- Pale Townsend's big-eared bat; and
- Western yellow-billed cuckoo.

The City's HCP program consists of species-specific conservation strategies designed to: 1) minimize and mitigate the impact of the proposed taking to the maximum extent practicable as required by Section 10 of the ESA; and 2) contribute to the long-term persistence of these species on regional and/or local level. As required by USFWS's Five Points Policy, the City will also develop species-specific monitoring and adaptive management programs where necessary to ensure achievement of the biological goals and objectives for each species.

This section presents the goals, objectives, and strategies for avoiding, minimizing, and mitigating impacts to the covered species. The specific conservation measures that the City would implement to achieve the species-specific goals and objectives are described. A monitoring and adaptive management program will complement these conservation measures (see Section 6).

5.2 Biological Goals and Objectives

5.2.1 Lesser Long-nosed Bat

There are no known lesser long-nosed bat (LLNB) roost sites within the Avra Valley HCP Planning Area. The nearest known maternity colony is approximately 45 miles northwest of the City (Old Mammon Mine); although historical records indicate that there were maternity colonies approximately 30 miles to the northwest (Picacho Peak) and 5 miles east of Tucson (Colossal Cave). Known non-maternity sites are located approximately 20 miles northeast of Tucson (Santa Catalina Mountains), 15 miles south of Tucson (Cave of the Bells), and 5 miles east of Tucson (Box Canyon crevice) (USFWS 2000a, 2002a, 2002b). The nearest individual was documented in the Santa Catalina Mountains, northeast of Tucson. All of the known roost sites in Pima County are protected by land management agencies and large areas of potential forage habitat can be found within the various National Parks, Monuments, and Wildlife Refuges (County 2000).

The foraging radius of LLNB may be on the order of 30 to 60 miles. Based on this information, portions of the Avra Valley HCP Planning Area could provide foraging habitat for LLNB. The extent of use of the planning area by foraging bats has not been determined; however, AGFD is undertaking telemetry studies to better determine LLNB foraging patterns in the Tucson Basin.

In early 2007, USFWS staff addressed the Technical Advisory Committee with regard to the status of LLNB within the Avra Valley HCP planning area. Scott Richardson (USFWS) reported that the species does occur within the planning area and that there is potential for incidental "take" to occur. He added that in terms of take, the needs of LLNB are: 1) roost sites (maternity, transition, night roosts); 2) foraging resources (pollen, nectar, saguaro fruits, agave nectar and pollen, and hummingbird feeders); and 3) habitat connectivity (ability to move between forage resources and roosts). Since there are roost sites and foraging resources on either side of Avra Valley, it is important appropriate vegetation be present within the Avra Valley corridors. The species need these corridors to move between sites . He added that any disturbance that prevents movement through movement corridors (e.g. fragmentation of washes and drainages) would constitute "take." (City of Tucson 2007).

Implementation of the proposed covered activities could result in the loss of potential LLNB foraging habitat in the HCP planning area. As there are no known LLNB roosts within the planning area, the potential for direct take of LLNB is very low. Long-term effects may include reduced foraging opportunities leading to greater energetic demands for bats as they seek alternative foraging site.

Specifically, the City's biological goal for LLNB is to:

- Contribute to maintaining regional populations of LLNB.

The City's specific objectives for LLNB are to:

- Provide for long-term availability of foraging corridors for LLNB; and
- Minimize potential for mortality of LLNB.

5.2.2 Cactus Ferruginous Pygmy-Owl

The only recent (since 1993) record of a pygmy-owl occurring within the planning area was of a single dispersing female on the Duval/Pennzoil Farm, the southernmost of the City-owned lands, in 2005. In 2003–2004, AGFD Research Branch tracked another female pygmy-owl crossing Avra Valley, but this female was not recorded on City lands (S. Richardson, USFWS, pers. comm.; D. Abbate, AGFD, pers. comm.). The planning area contains no suitable breeding habitat for this species; however, there are 2,097 acres (849 hectares) of over-wintering habitat and 1,838 acres (744 hectares) of dispersal habitat. In addition, Proposed Critical Habitat Unit (CHU) 2 for the pygmy-owl encompasses portions of the planning area (FR 2002). CHU 2 was established primarily to provide connectivity and allow for dispersal of CFPO between nesting areas in CHU 1, CHU 3, CHU 4, and the Tohono O'odham Nation. Providing areas for dispersal is necessary for the maintenance and expansion of pygmy-owl subpopulations. USFWS reports that CHU 2 provides breeding, roosting, perching, and foraging habitat and maintains an important linkage among blocks of nesting habitat both locally and over the pygmy-owl's range that is essential to the species' conservation. The CHU also contains habitat that may become more important for nesting if the overall CFPO population expands (FR 2002).

Implementation of the proposed covered activities will result in the loss of potential over-wintering and dispersal habitat in the HCP planning area. Direct take of pygmy-owls is not likely. The indirect effects of these projects may include reduction in native prey base and disturbance by humans, e.g., construction and maintenance activities. Long-term effects of the proposed covered activities may include reduced opportunities for dispersal between known populations of owls leading to isolation and reduced owl pairings.

Based on this information, the City's biological goals and objectives for pygmy-owl relate to ensuring that development activities within the planning area do not lead to the permanent loss of pygmy-owls and will maintain sufficient habitat to support significantly more owls than are currently present.

Specifically, the City's biological goal for CFPO is to:

- Contribute to maintaining local and regional populations of CFPO.

The City's specific objectives for CFPO are to:

- Provide for long-term availability of suitable dispersal and over-wintering habitat for pygmy-owls;
- Reduce barriers to movement for pygmy-owls; and
- Minimize potential for mortality of pygmy-owls; and
- Preserve breeding opportunities to support potential expansion of pygmy-owl distribution resulting from augmentation elsewhere in the pygmy-owl's range.

5.2.3 Burrowing Owl

AGFD (Grandmaison and Urreiztieta 2006) evaluated 35 City-owned Avra Valley properties in November 2005 for burrowing owl nesting habitat potential, characterizing each property according to vegetation density, presence of concrete irrigation canals, and availability of usable burrows. Then, AGFD personnel conducted winter and breeding season surveys for owls in suitable locations during 2006. Burrowing owls were present on nine properties and suitable burrows were detected on 16 of them. The winter survey conducted by AGFD in January and February 2006 detected a total of 1,836 burrows suitable for burrowing owl use based on opening dimensions and burrow depth. Based on this information, the City's biological goals and objectives for burrowing owls relate to providing conditions to support breeding, over-wintering, and migration by burrowing owls.

Specifically, the City's biological goal for burrowing owls is to:

- Contribute to maintaining local and regional populations of burrowing owls.

The City's specific objectives for burrowing owl are to:

- Increase the number of breeding pairs of burrowing owls in the City and support breeding pairs in the City over the HCP permit term; and
- Provide habitat for over-wintering and migrating owls.

5.2.4 Tucson Shovel-Nosed Snake

The current Tucson shovel-nosed snake population status within the Avra Valley planning area is unknown. The Avra Valley planning area contains approximately 2,450 acres (991 hectares) of potential shovel-nosed snake habitat. The last known record of the Tucson shovel-nosed snake in the vicinity of the planning area was at Sanders Road and Avra Valley Road in 1979. It is unknown whether the species persists within Pima County. It was not observed during species-specific surveys conducted in and around Marana in 2003. However, these surveys were initiated during the latter half of the seasonal activity cycle when the snake was much less active. The record of a Tucson shovel-nosed snake observed near Picacho in 2004, however, demonstrates that the species is not regionally extinct and may still inhabit Avra Valley.

Implementation of the proposed covered activities will result in the loss of potential habitat in the HCP planning area. Direct take of shovel-nosed snake individuals may occur as a consequence of development-associated ground disturbance activities. The indirect effects of development may impact the snake through facilitation of invasion or increased densities of exotic plants and disturbance by humans during construction or maintenance of facilities. Long-term effects may include fragmentation of habitat and isolation of habitat patches.

Specifically, the City’s biological goal for the Tucson shovel-nosed snake is to:

- Contribute to maintaining local and regional Tucson shovel-nosed snake populations.

The City’s specific objectives for Tucson shovel-nosed snakes are to:

- Provide for long-term availability of suitable Tucson shovel-nosed snake habitat; and
- Minimize loss of Tucson shovel-nosed snake individuals.

5.2.5 Ground Snake

The status of the ground snake population within the Avra Valley planning area is currently unknown. At this time, approximately 1,192 acres (482 hectares) of potential ground snake habitat have been identified in the Avra Valley HCP planning area. There are no known observations of ground snakes within the HCP planning area. Several records of the ground snake, including observations of the snake in 2003 and 2004, show that it has occurred along the Blanco Wash, from its confluence with the Santa Cruz River south to Avra Valley Road. Although these records serve to confirm the presence of this snake in the vicinity of the HCP planning area, they are not sufficient to determine the current local abundance or population status of the species.

Implementation of the proposed covered activities will result in the loss of potential habitat in the HCP planning area. Direct take of ground snake individuals may occur as a consequence of development-associated ground disturbance activities. The indirect effects of development may impact the snake through facilitation of invasion or increased densities of exotic plants and disturbance by humans during maintenance of facilities. Long-term effects may include fragmentation of habitat and isolation of habitat patches.

Specifically, the City’s biological goal for the ground snake is to:

- Contribute to maintaining local and regional ground snake populations.

The City’s specific objectives for ground snakes are to:

- Provide for long-term availability of suitable ground snake habitat; and
- Minimize loss of ground snake individuals.

5.2.6 Pale Townsend’s Big-Eared Bat

According to the HDMS (AGFD, unpublished data accessed 2003), there are no known PTBB roost sites within the HCP planning area. In eastern Pima County, this species is known to use Colossal Cave Mountain Park, Tucson Mountain Park, and SNP (County 2000b). Given the low elevations and relatively flat topography of the HCP planning area, there is little to no potential that undocumented roosts sites are present.

Implementation of anticipated covered activities may result in the loss of potential PTBB foraging habitat in the HCP planning area due to water supply projects and associated infrastructure. Direct take of foraging bats is not likely. Mortality, resulting from impacts of maintenance or treatment activities, may occur when bats are occupying night roosts. The indirect effects of this development may impact the bat through the reduction in its native prey base, predation by domestic animals, and disturbance by humans. The most significant threat to this species, however, is loss of potential maternity and long-term day roost sites through closure of adits and mine shafts, disturbance of mine shafts and caves, improper cave gating, and renewed mining activities. However, the Avra Valley planning area contains no suitable maternity or long-term day roost sites.

Specifically, the City's biological goal for PTBB is to:

- Contribute to maintaining regional populations of PTBB.

The City's specific objectives for PTBB are to:

- Provide year-round foraging opportunities for PTBB; and
- Minimize potential for direct take of foraging PTBB.

5.2.7 Yellow-Billed Cuckoo

The current level and pattern of use of the Avra Valley planning area by WYBC is unclear. A few cuckoos have been documented migrating through or near the planning area, but specific use of habitats in the planning area for migration has not been verified. There are currently no documented breeding records within the planning area; however, there is recent evidence of breeding season use at Simpson Farm North, suggesting that river restoration efforts along the Santa Cruz River may produce stands of hydroriparian vegetation suitable to support a limited number of breeding cuckoos. Based on this information, the City's biological goals and objectives for WYBC in the planning area primarily relate to providing conditions to support migration. However, the conservation program also addresses the possibility of breeding activity at specific sites along the Santa Cruz River.

Specifically, the City's biological goal for yellow-billed cuckoo is to:

- Contribute to maintaining local and regional populations of WYBC

The City's specific objectives for WYBC are to:

- Provide for long-term availability of suitable dispersal and possible breeding habitat for WYBC; and
- Minimize potential for mortality of WYBC.

5.2.8 Other Management Issues

Buffelgrass management has become an immediate concern for the Sonoran Desert region due to the high flammability of this non-native invasive African grass species in conjunction with the severe drought the area is experiencing. The City of Tucson is addressing infestations on its Avra Valley land holdings, and on areas within City limits, and is working with other entities to identify and undertake long-term eradication and control efforts. The City has worked with the University of Arizona, USGS, Tucson Audubon Society, and other experts to evaluate the efficacy of buffelgrass removal methods and identify approaches to re-introduce native vegetation to sites while preventing further buffelgrass establishment.

The City is one of a number of partners who have worked to create a Cooperative Weed Management Area and develop the Buffelgrass Strategic Plan to address control of buffelgrass and other invasive species on a regional basis.

The Buffelgrass Strategic Plan includes steps to map and track buffelgrass infestations and treatment areas, prioritize areas needing eradication, coordinate eradication efforts, research the effectiveness of eradication techniques, develop an Intergovernmental Agreement to increase coordination opportunities between jurisdictions and agencies, and undertake public outreach efforts in the community. Multiple City Departments will be involved in the treatment of buffelgrass. Tucson Water is the lead Department for management of the Avra Valley land holdings, and will take the lead on buffelgrass control on these lands. Other City departments, including Transportation, Parks and Recreation, Urban Planning, and Fire, have roles to play in responding to the buffelgrass threat within City Limits, including future annexed areas.

The state of the Altar/Brawley Wash has been a concern to local resource managers for several decades. In 1992, the Soil Conservation Service (now NRCS), in cooperation with the Pima Natural Resource Conservation District, published a natural resource restoration plan for the Brawley Watershed. This report identified a number of issues within the watershed including: 1) stream bank erosion and associated loss of riparian and range habitat along the Brawley Wash; 2) sheet, rill, and gully erosion and associated damages to rangeland and improvements; 3) sedimentation effects on downstream water quality, farmland, and county and state road crossings; 4) flash flooding and associated damages to roads, farmland, and local communities; and 5) loss of groundwater recharge due to accelerated flows within the incised wash.

Dr. Phil Rosen was contracted by the City to assess the level of degradation to City-owned lands because of past agricultural uses and to evaluate the potential for natural recovery or restoration of these properties to a more natural and better functioning state. Dr. Rosen stated that:

> *Large portions of Brawley Wash…are highly degraded barrens with adobe soils and low perennial plant diversity…Restoration of the Brawley Flats that would be valuable enough to justify the effort and costs that would be likely should, in my evaluation, include especially the partial elimination of enhanced drainage of the flats, and the partial increase of "overbank flood storage" – the restoration of sheet flow and short-duration standing water on broad areas of the Brawley Floodplain.*

5.3 Conservation Measures

Through implementation of the conservation program, the City seeks to avoid, minimize, and mitigate potential impacts to all covered species. The City's conservation strategy, which is based on the species-specific goals and objectives outlined above, consists of the following components:

- Maintain suitable habitat within the planning area (Sections 5.3.2–5.3.4);
- Minimize direct adverse impacts associated with future water development projects (Section 5.3.5); and
- Promote integrated, regional conservation planning (Section 5.3.6).

The specific conservation measures that the City will implement are detailed below. A monitoring and adaptive management program will complement the conservation measures (see Section 6).

5.3.1 Phasing

With the exception of continued expansion of the Clearwater Program (CAVSARP), future water infrastructure development on the Avra Valley lands is uncertain both in scope and in timing. In fact, there is no current certainty that any of the potential activities will occur. In order to address this uncertainty, the implementation of the conservation program will be tied to actual implementation of individual projects. Since the scope and location of proposed covered activities is not yet known, more detailed requirements will be determined at the time that individual projects are implemented. Specific aspects of the phasing of the conservation program will be discussed in more detail in the subsections below.

5.3.2 Maintain Suitable Habitat in the Planning Area

The majority of land within the HCP planning area is former agricultural fields that were purchased by the City 20 to 30 years ago. As a result, there is a wide range of habitat quality within the planning area, ranging from uncultivated areas that have been impacted in varying degrees by grazing, the proliferation of invasive species, ORV use, and human pedestrian traffic to the denudation and loss of soil fertility and structure associated with former agricultural fields. The rate of recovery of the former farmland is varied, depending on factors such as intensity of farming efforts, soil type, and proximity to watercourse. For species such as the Tucson shovel-nosed snake and ground snake, it is unknown at which point farm fields made unsuitable by native species removal and soil compaction will have recovered sufficiently to become suitable habitat.

In order to maintain suitable habitat for each covered species within the planning area, four conservation strategies have been considered. These are:

- Preservation of existing suitable habitat within the HCP planning area;
- Enhancement of degraded or marginal habitat within the HCP planning area;
- Restoration of currently unsuitable, but restorable, habitat within the HCP planning area; and
- Mitigation outside of the HCP planning area through off-site restoration or habitat protection.

The preservation of existing suitable habitat within the planning area is preferable to both on-site restoration of habitat or off-site mitigation. Primary emphasis in the conservation program is, therefore, placed on protection of existing suitable habitat. Restoration of habitat is proposed only in situations where preservation of existing suitable habitat is not sufficient to adequately mitigate the impacts of proposed covered activities. Mitigation outside of the HCP planning area will only be used as a last resort.

PRESERVATION OF EXISTING SUITABLE HABITAT

The primary strategy for conservation of the covered species in this HCP is the protection of existing habitat. The seven covered species use the planning area in different ways. The focus of this measure is to preserve those species-specific habitat functions that currently exist within the planning area, specifically to:

- Maintain existing suitable lesser long-nosed bat foraging habitat;
- Maintain existing suitable pygmy-owl dispersal and over-wintering habitat;
- Maintain existing suitable burrowing owl breeding and dispersal habitat;
- Maintain existing suitable year-round Tucson shovel-nosed snake habitat;

- Maintain existing suitable year-round ground snake habitat;
- Maintain existing suitable pale Townsend's big-eared bat foraging habitat;
- Maintain existing suitable yellow-billed cuckoo dispersal and possible breeding habitat;

Figure 5.3-1 shows all seven species' habitats while figure 5.3-1 shows potential habitat within the HCP planning area by number of species.

Table 5.3-1. Covered Species and Associated Habitat by Farm within the HCP Planning Area

Farm	Potential CFPO over-wintering, LLNB, and WYBC habitats	TSS potential habitat	CFPO potential dispersal habitat	GS potential habitat	PTBB potential habitat	BUOW potential habitat	TOTAL Habitat[1]	TOTAL habitat footprint (overlapping habitats merged)
98	20	37	97	0	13	168	375	274
Anway	188	44	43	44	0	290	983	290
Bowden	2	13	14	0	0	496	528	512
Buckalew	335	0	502	0	632	227	2,366	886
Cactus Avra	0	10	0	58	0	299	366	366
Cactus Milewide	20	10	21	0	0	333	424	377
Chu	0	11	0	0	0	303	314	303
Comiskey	58	87	110	0	44	0	414	206
Davidson	13	0	16	0	0	0	55	29
Duval / Pennzoil	353	0	73	0	376	105	1,612	830
Ed Anway	112	177	94	139	115	0	861	296
Flying E Bar	7	5	8	154	0	0	187	172
Gin	5	7	37	0	4	249	311	291
Glover	0	35	0	0	10	143	188	166
Hill	0	0	0	0	0	0	0	0
Hurst	32	75	65	267	99	128	729	391
Jarvis North	200	480	19	0	229	0	1,327	480
Jarvis South	0	0	0	0	0	302	302	302
Kai	0	0	0	159	0	0	159	159
Levkowitz	46	0	0	0	3	0	141	49
Lupori	0	0	0	0	0	0	0	0
Martin	7	14	0	0	0	129	165	129
Nichols	0	0	0	27	0	0	27	27
Reeves North	116	116	105	0	70	0	639	228
Reeves South	124	437	313	0	320	38	1,480	437
Santa Cruz	31	75	2	7	46	1,104	1,327	1,128
Simpson North	31	36	46	0	0	122	297	144
Simpson South	0	79	2	86	152	129	448	285
Trust 205	348	348	0	202	124	0	1,717	348
Tucker	0	0	0	49	0	601	651	602
Wallis	48	284	243	0	28	0	698	396
Weinstein	4	70	28	0	45	0	155	70

[1]CFPO over-wintering, LLNB, and WYBC habitats each summed separately even though habitat overlaps.

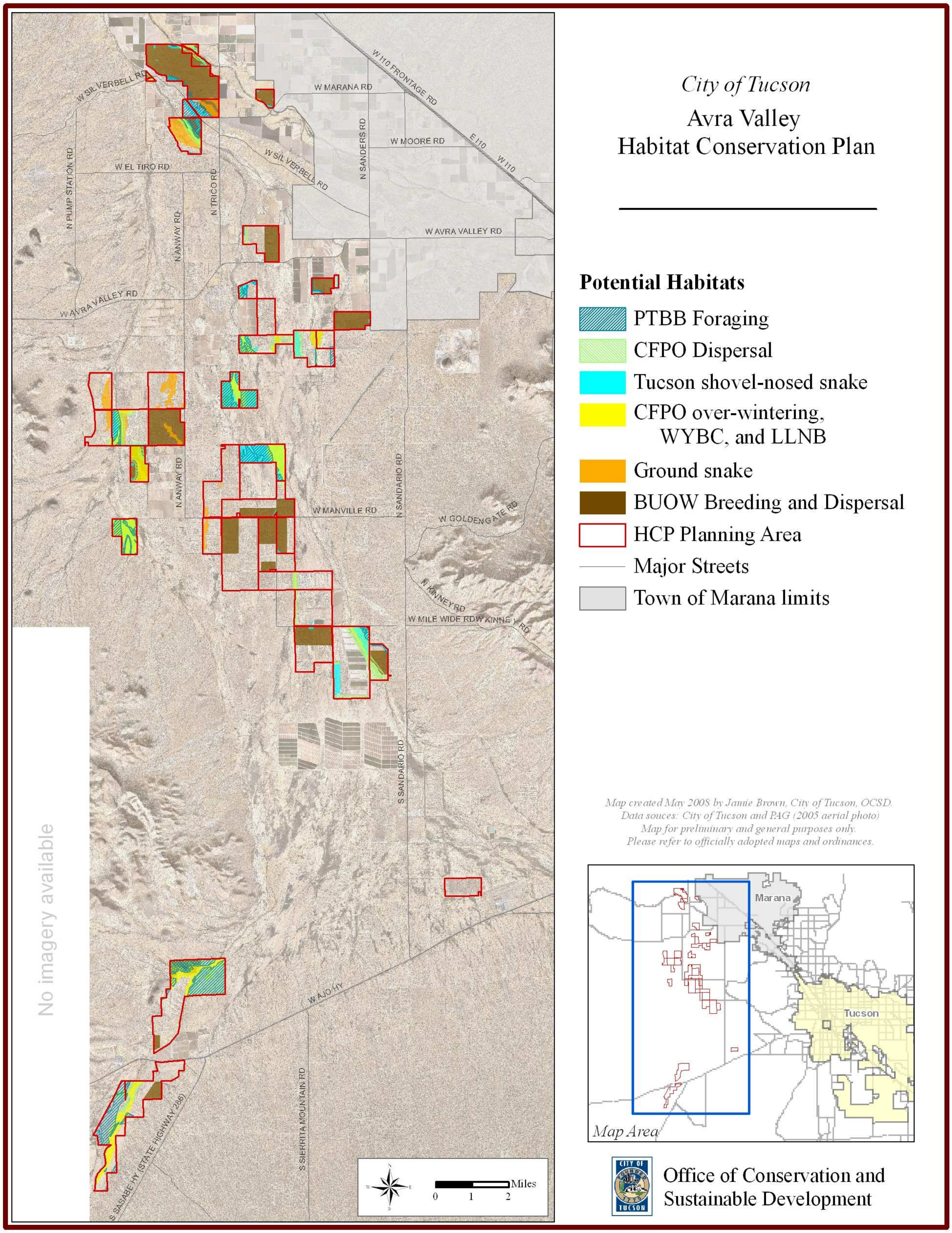

Figure 5.3-1. Potential suitable habitats.

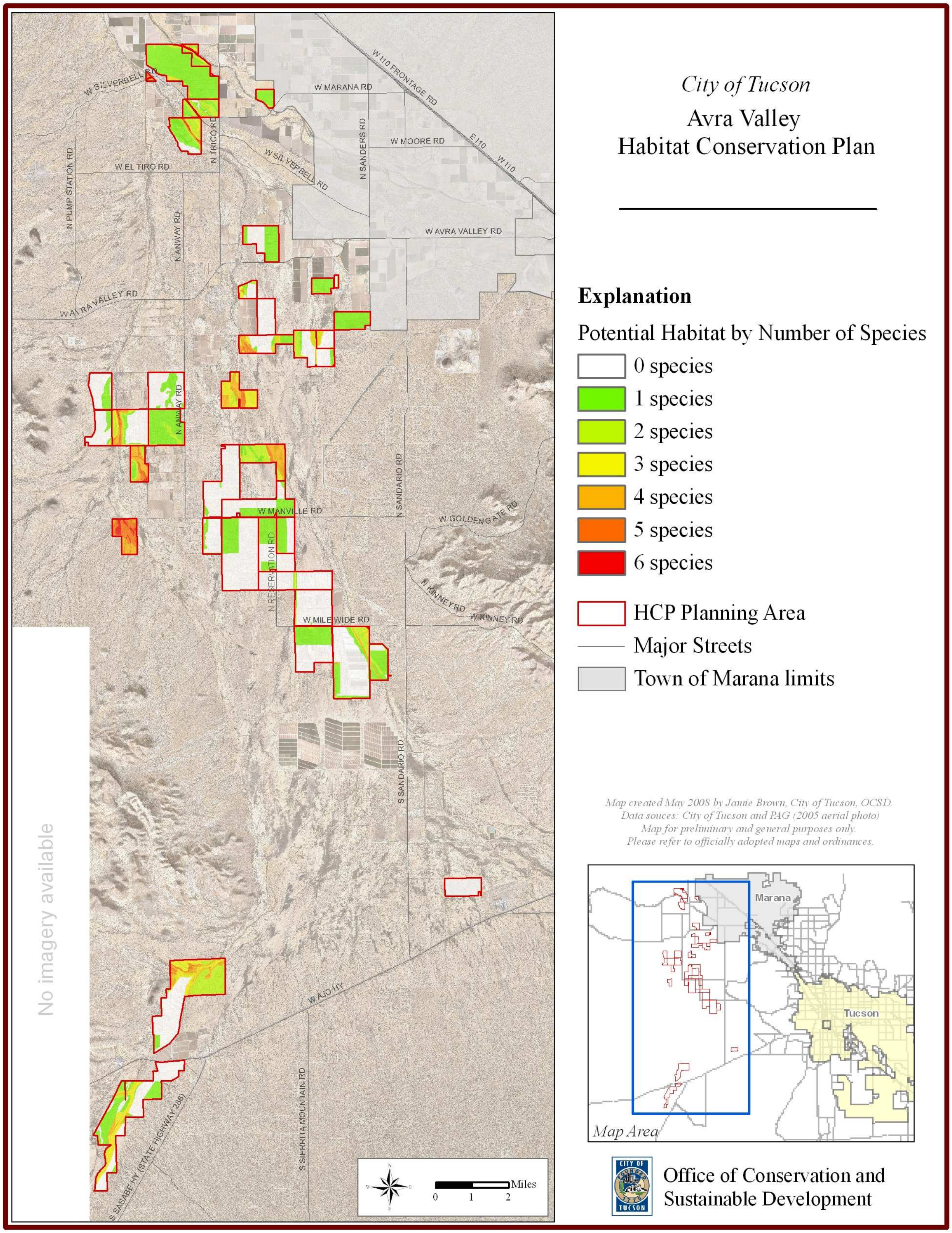

Figure 5.3-2. Potential suitable habitat composite map.

Table 5.3-2. Covered Species and Associated Habitat within the HCP Planning Area

Species	**Total Habitat in Planning Area** (acres)
Lesser long-nosed	2,097
Pygmy owl (over-wintering habitat)	2,097
Pygmy-owl (dispersal habitat)	1,838
Burrowing owl	5,167
Tucson shovel-nosed snake	2,450
Ground snake	1,192
Pale Townsend's big-eared bat	2,310
Western yellow-billed cuckoo	2,097
Total	19,248
Total habitat footprint (overlapping habitats merged)	10,174

***Conservation Strategy 1**: Preserve suitable habitat through conservation easement, acquisition, or other mechanism that results in permanent protection, for each covered species for which suitable habitat is impacted by the development of a project covered under this HCP.*

The following habitat preservation guidelines will apply to all covered activities implemented within the HCP planning area. Impacts to suitable habitat will be mitigated at particular ratios for each covered species. Mitigation ratios indicate the acres of suitable habitat that will be preserved for each acre of suitable habitat lost to development of the covered activities. Mitigation ratios are shown in Table 5.3-3.

Table 5.3-3. Mitigation Ratios for Covered Species

Species	Mitigation Ratio (Preserved habitat: Developed habitat)
LLNB	3:1
CFPO over-wintering	3:1
CFPO dispersal	2:1
BUOW	1:1
TSS	3:1
GS	2:1
PTBB	1:1
WYBC	3:1

Table 5.3-4. Mitigation credit by scenario

Mitigation credit received for 1 acre of…	LLNB	CFPO	BUOW	TSS	GS	PTBB	WYBC
Preservation of suitable habitat within the planning area	1 acre	1 acre	1 acre	1 acre	1 acre	1 acre	1 acre
Enhancement or restoration of habitat in the planning area	¾ acre	¾ acre	2 acres	¼ acre	½ acre	2 acres	¾ acre
Preservation of habitat outside the planning area	¾ acre	¾ acre	½ acre	¼ acre	½ acre	½ acre	¾ acre

Lesser Long-Nosed Bat

The LLNB is listed as a federally endangered species. It is known to use the planning area to travel between foraging resources and roosting habitats. Although there is no known breeding habitat within the planning area, the conservation strategy focuses on preservation of the foraging corridors. Given its sensitive status, a mitigation ratio of 3:1 is appropriate for the foraging habitat of this species, which is the same as the CFPO over-wintering and WYBC dispersal and possible breeding habitats.

As long as priority is given to preserving suitable habitat within the planning area, protection of any existing suitable habitat within the HCP planning area has roughly the same value for this species. While preservation of any existing suitable habitat within Avra Valley would have value for this species, protection or restoration of habitat in the HCP planning area should take precedence over protection of habitat outside the planning area. The lower mitigation credit received for preservation of habitat outside the planning area reflects both the importance of ensuring that adequate dispersal habitat and corridors remain in the planning area and the level of conservation value that the County places on the lands surrounding the individual parcels in the City HCP planning area. The County has purchased several adjoining lands for conservation purposes and intends to purchase several more. Almost all private lands within the valley are considered by the County to be either Biological Core areas or Important Riparian Areas, with conservation requirements of 80 and 95 percent, respectively.

Cactus Ferruginous Pygmy-Owl

The CFPO has recently been de-listed as a federally endangered species. However, the USFWS is currently reviewing a petition for re-listing, increasing the likelihood that the species will be re-listed within the life of the permit. Due to very low population numbers and the sensitivity of this species to disturbance, a mitigation ratio of 4:1 is the standard request in Section 7 consultations for projects within breeding habitat for this species. There is no breeding habitat within the City HCP planning area, only potential over-wintering and dispersal habitat. There have also been few recorded instances of pygmy-owls dispersing through Avra Valley and no records of over-wintering. The conservation strategy for this species, as outlined below, pays special attention to the preservation of those corridors most likely to be used by dispersing pygmy-owls. Based on these factors, it is felt that a 3:1 mitigation ratio for over-wintering habitat and a 2:1 mitigation ratio for dispersal habitat are sufficient to preserve the ability of the HCP planning area to support dispersing owls.

As long as priority is given to preserving suitable habitat within the planning area, protection of any existing suitable habitat within the HCP planning area has roughly the same value for this species. Restoration of habitat does not have the same value as preservation of existing habitat; however, because of the high potential for success of these types of effort, it should remain a viable option. Restoration of habitat in the Avra Valley HCP planning area, as long as it is paired with the preservation of existing suitable habitat, could actually improve the likelihood that pygmy-owls will use those areas, particularly if the restoration greatly improves availability of escape cover, promotes increased prey base, and reduces flight distances between perching trees.

While preservation of any existing suitable habitat within Avra Valley would have value for this species, protection or restoration of habitat in the HCP planning area should take precedence over protection of habitat outside the planning area. The lower mitigation credit received for preservation of habitat outside the planning area reflects both the importance of ensuring that adequate dispersal habitat and corridors remain in the planning area and the level of conservation value that the County places on the lands surrounding the individual parcels in the City HCP planning area. The County has purchased several adjoining lands for conservation purposes and intends to purchase several more. Almost all private lands within the valley are considered by the County to be either Biological Core areas or Important Riparian Areas, with conservation requirements of 80 and 95 percent, respectively.

Table 5.3-5. Mitigation Ratios Required for Each Mitigation Option

Mitigation ratios required for each mitigation option	LLNB	CFPO (over-wintering)	CFPO (dispersal)	BUOW	TSS	GS	PTBB	WYBC
Preservation of suitable habitat in the planning area	3:1	3:1	2:1	1:1	3:1	2:1	1:1	3:1
Enhancement or restoration of habitat in the planning area	4:1	4:1	2.67:1	0.5:1	12:1	4:1	0.5:1	4:1
Preservation of habitat outside the planning area	4:1	4:1	2.67:1	2:1	12:1	4:1	2:1	4:1

Burrowing Owl

Burrowing owls are not currently a federally or state-listed species. They appear to be declining within their range, and it is clear that large areas of suitable burrowing owl habitat are being converted for urban development, particularly in the Phoenix area. There are a number of known populations in the Tucson basin; however, the population size and trend are not known. Burrowing owls do use the HCP planning area. A survey completed in 2006 found 34 owls in the wintering season and four apparently unpaired owls in the breeding season. No breeding activity has been documented within the City HCP planning area. In addition, that survey found 1,836 suitable burrows within the planning area, but only 292 showed any signs of recent or past use, and 40 percent of those were destroyed by flooding between the spring and winter surveys. The relatively low numbers of burrowing owls may be a function of a limited prey base resulting from extensive pesticide and herbicide use on these former agricultural lands, a lack of suitable, stable burrows, or some other factor. Given the low numbers of owls within the planning area and the potential to improve habitat suitability by creating dedicated, managed areas for the species, Burrowing Owl Management Areas (BOMAs) will be established to meet the goals and objectives for the species. See Section 5.3.4 for more details on the BOMAs.

Since burrowing owls can respond well to active management of their habitat, enhancement of burrowing owl habitat within the planning area has the potential to provide strong benefits to this species. As a result, enhancement of habitat receives a higher mitigation credit than just preservation of existing suitable habitat. Since burrowing owl use of areas may be sporadic and temporary, it would difficult to determine with confidence that any particular area, even if owls are documented on the property at present, will be used by owls over the long-term. Therefore, preservation of existing habitat outside of the

HCP planning area has less reliable value and receives a lower mitigation credit than preservation of habitat in the planning area.

Tucson Shovel-Nosed Snake

The Tucson shovel-nosed snake has been petitioned for federal listing. This species occupies a fairly restricted range in south-central Arizona, including into northern Pima County. Given the sensitive status of Tucson shovel-nosed snakes, and the likelihood of listing in the near future, a mitigation ratio of 3:1 is appropriate for the habitat of this species. This is consistent with the treatment of another species that was previously listed as endangered and has very low known population numbers within its range in the U.S., the pygmy-owl.

Restoration of habitat for this species is not highly recommended as it is currently not known what would be needed to restore degraded land to full suitability. The low certainty of success of restoration efforts is reflected in the low mitigation value that these activities receive.

Ground Snake

Ground snakes are not currently federally or state-listed species and local experts feel that it is unlikely that these snakes will become listed within the planning period. These species are known to do well within urban settings and are likely to be less impacted by disturbance within their habitat than more sensitive species, such as the Tucson shovel-nosed snake and Western yellow-billed cuckoo. Given the low documented numbers of this species, ground snake habitat has a slightly higher mitigation ratio (2:1) than other disturbance-tolerant covered species, specifically the burrowing owl and PTBB.

Restoration of habitat for this species is not highly recommended as it is currently not known what would be needed to restored degraded land to full suitability. The low certainty of success of restoration efforts is reflected in the low mitigation value that these activities receive.

Pale Townsend’s Big-Eared Bat

The primary threat to PTBB relates to availability of breeding and wintering roosts. There are no potential roost sites within the planning area. The bat may use the HCP planning area as foraging habitat, but it typically forages within 15 miles of roost sites. Since the use of the HCP planning area by this species is likely to be low, the mitigation ratio for the bat is 1 acre of suitable habitat preserved for every acre of suitable habitat impacted (1:1 ratio).

Management of suitable habitat to reduce the amount of non-native plant species and improve the diversity and abundance of the native species that support the native insects that this bat consumes would improve the quality of foraging habitat within the planning area. As a result, enhancement or restoration of habitat receives a higher mitigation credit than does just preserving existing suitable habitat. Since the bat’s use of areas is difficult to ascertain, it would difficult to determine with confidence that any particular area will be used by bats over the long-term. Therefore, preservation of existing habitat outside of the HCP planning area has less reliable value and receives a lower mitigation credit than preservation of habitat in the planning area.

Western Yellow-Billed Cuckoo

The Western yellow-billed cuckoo is a candidate species, meaning that there is sufficient evidence of threat to the cuckoo to warrant federal listing. This species uses a scarce and sensitive habitat, namely cottonwood-willow galleries and, in some cases, mesquite bosques. These habitats are difficult to re-create once lost, and little existing suitable habitat is found within the HCP planning area. As a result, impacts to cuckoo habitat should be avoided at all cost, but where minor impacts are allowable, they will be mitigated at a 3:1 ratio.

The loss of suitable habitat for this species in the Tucson Basin is largely a function of a lower water table. Current and projected future demands for water make it unlikely that the water table will ever recover to a level that will support significantly more meso- and hydro-riparian habitats. Restoration of cuckoo habitat will therefore require inputs of water from an artificial source (e.g., irrigation) and the success of this type of restoration effort is uncertain. Due to the difficulty of re-creating suitable cuckoo habitat, restoration as a mitigation option is not favored and has a lower mitigation value than preservation of existing habitat.

5.3.3 Guidelines for Maintaining Suitable Habitat

As previously discussed, the uncertain scope, location, and timing of City projects within the HCP planning area over the 50-year life of the incidental take permit necessitate a flexible approach to maintaining suitable habitat. Depending on community needs for water and energy infrastructure, on one side of the development spectrum, no new projects would occur within the planning area. On the other side of the spectrum, it is possible that all the covered activities, or activities with a similar land use intensity, will occur.

Although a flexible conservation program is necessary to preserve options for maintaining vital water and energy infrastructure for the community, the following Priority Mitigation Areas will serve as an initial framework from which to proceed. Ultimately, however, development could take place anywhere within the HCP planning area, except for the riparian habitats. Deviance from the Priority Mitigation Area concept would only occur should the City's infrastructure needs change substantially from what is currently envisioned. In that case, mitigation will still occur according to tables 5.3-1 through 5.3-5.

PRIORITY MITIGATION AREAS

Areas within the HCP planning area have been identified as Priority Mitigation Areas not only for their habitat value for the covered species, but other biological values as well. These include:

- Being within landscape level biological corridors;
- Adjacency to a federal preserve thus increasing habitat contiguity;
- Proximity or adjacency to County open space acquisition priority;
- Proximity to hydroriparian habitat;
- Proximity to lands being restored as wildlife habitat, or;
- Proximity to lands previously used as relocation sites for burrowing owls.

Because of these additional biological factors, the Priority Mitigation Areas also help meet regional goals for open space protection, habitat preservation, and the protection of sensitive species. Lands part of the Priority Mitigation Areas include riparian habitats identified through examining aerial orthoimagery, the Trust 205 Farm, the uncultivated portion of Buckalew Farm, and the northernmost lands within the planning area. These northernmost lands are also known as the Santa Cruz River Block (Hurst, Martin, Santa Cruz, Simpson North, and Simpson South Farms). Figure 5.3-3 shows these priority mitigation areas in context with federal and County preserves as well as County open space acquisition priorities and biological corridors.

As Priority Mitigation Areas, these lands will be the first choice for mitigation should a project impact species habitat, with the non-Priority Mitigation Areas, or Impact Areas, being used as the secondary mitigation option. Table 5.3-6 provides a guide to the amount of mitigation required and indicates the extent to which Priority Mitigation Areas can accommodate the requirements. Once Priority Mitigation Areas have been mitigated to the fullest extent, mitigation within the Impact Areas will occur. At the point which all mitigation lands within the Priority Mitigation Areas and Impact Areas have been set-aside, either habitat enhancement / restoration will need to occur or off-site mitigation will be necessary. Figure 5.3-4 illustrates where mitigation, by ratio, is required or is possible, depending on how the land is used.

Table 5.3-6. Planning Area Mitigation Needs (all values in acres)

Species	Habitat in Impact Areas	Mitigation needed for 100% disturbance of Impact Areas	Mitigation available in Priority Mitigation Areas	Amount of impact in Impact Areas mitigated by Priority Mitigation Areas	Maximum impact to habitat allowable in Impact Areas	Impact Areas that cannot be mitigated within the Planning Area
CFPO over-wintering, LLNB, and WYBC	231	692	1,866	622	524	0
TSS	1,300	3,901	1,149	383	612	688
GS	521	1,042	320	107	245	276
CFPO dispersal	546	1,092	581	194	311	235
PTBB	342	342	171	57	200	143

CAVSARP COMPLEX

While there is no certainty over where impact will occur within the planning area throughout the life of the permit, the lands near the Central Avra Valley Storage and Recovery Project (CAVSARP) are most likely to be impacted by covered activities. This “CAVSARP Complex” of lands consists of nine farms—98, Bowden, Cactus Milewide, Davidson, Jarvis North, Jarvis South, Nichols, Wallis, and Cactus Avra—totaling 8,157 acres. Proximity to CAVSARP, natural gas distribution pipes, and electricity transmission lines, along with the relative proximity to the City limits elevate the value of these lands above others in the planning area for future development. Should lands the CAVSARP Complex become prioritized for development, mitigation would occur according to table 5.3-7. The impact areas and the CAVSARP complex are shown in figure 5.3-5.

Despite this planning forecast for development most likely to occur within the CAVSARP Complex, ultimately, however, development could take place anywhere within the HCP planning area, except for the riparian habitats.

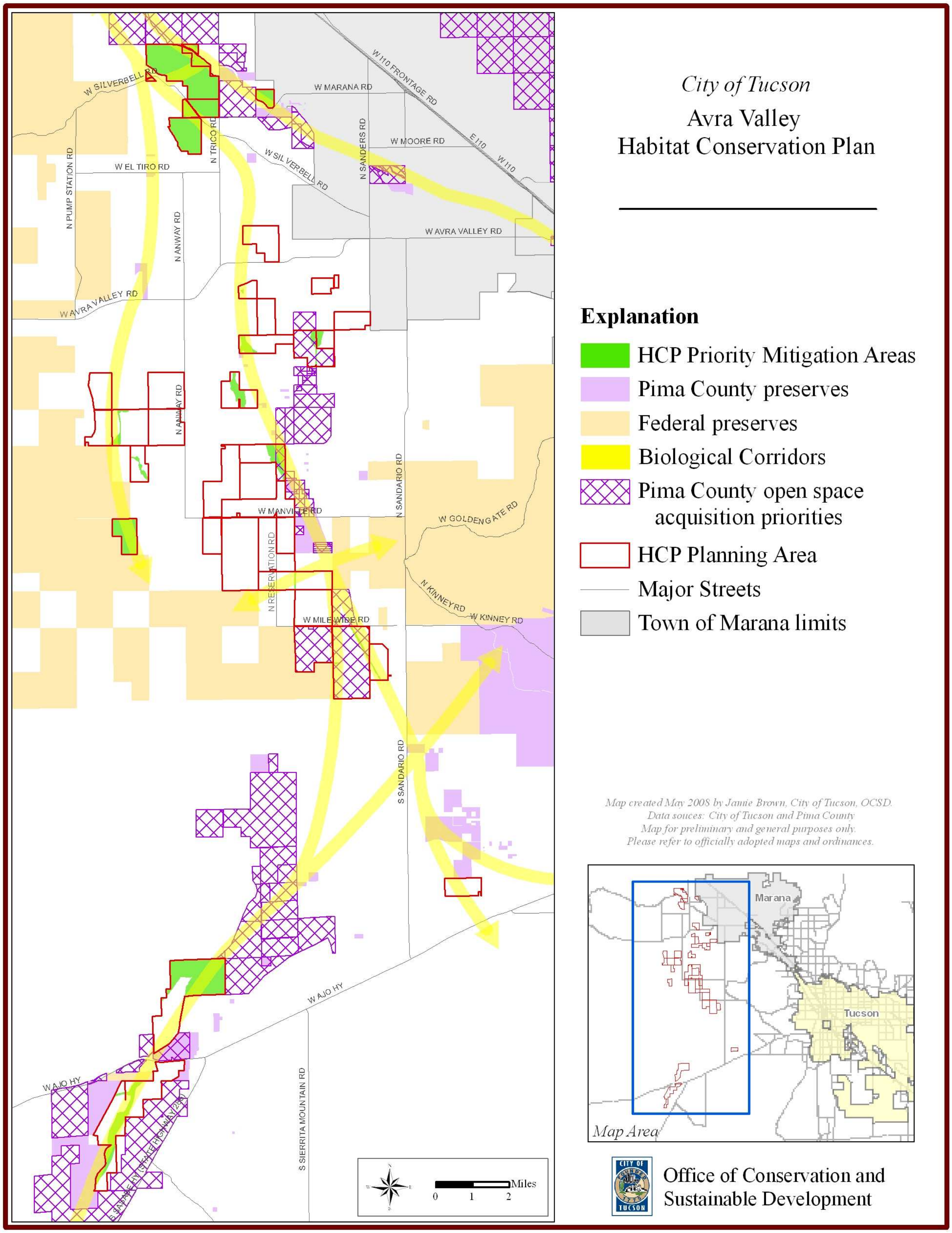

Figure 5.3-3. HCP priority mitigation areas, federal and County preserves, biological corridors, and County open space acquisition priorities.

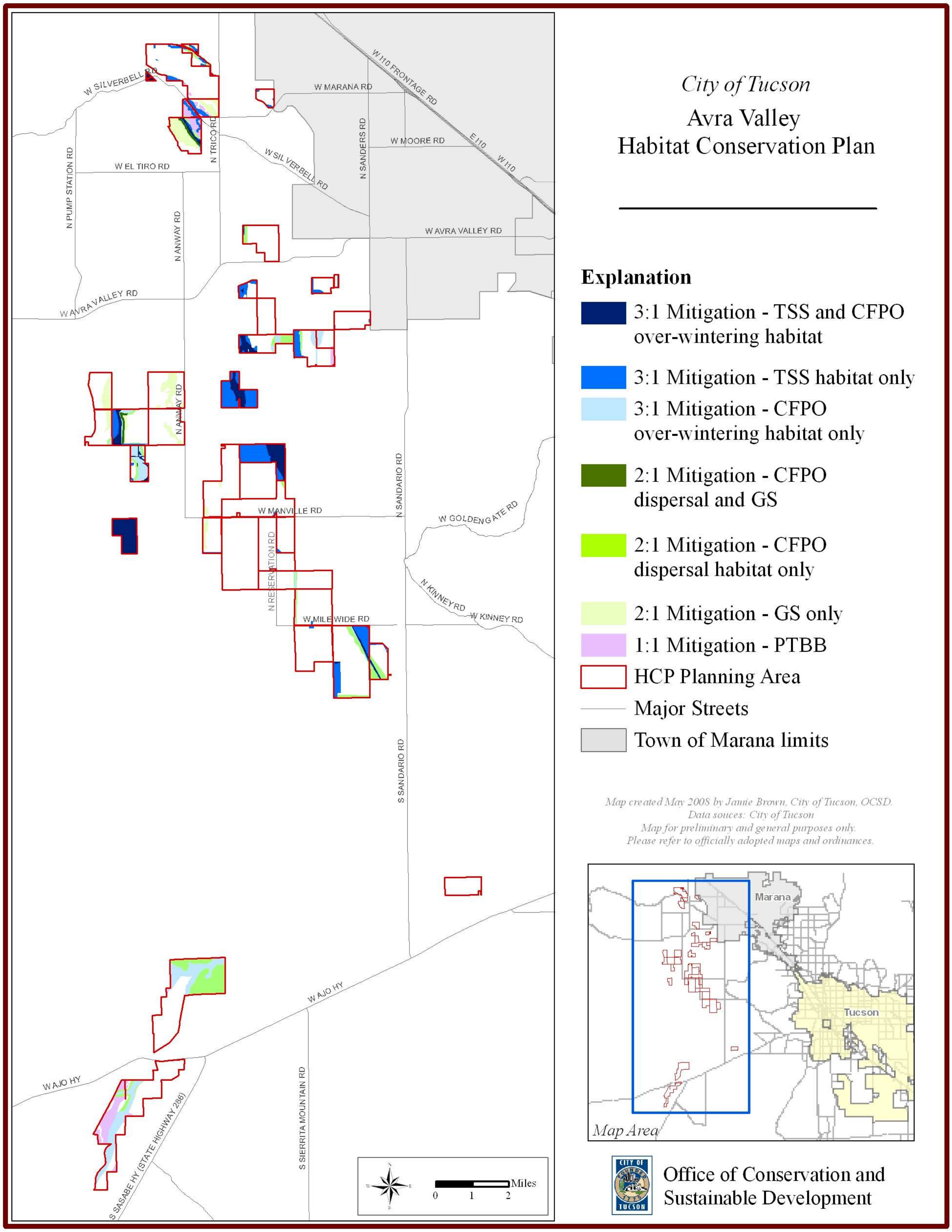

Figure 5.3-4. Mitigation levels based on covered species habitat location and established ratios

Table 5.3-7. CAVSARP Complex Mitigation Needs (all values in acres)

Species	Habitat within CAVSARP Complex (outside of Priority Mitigation Areas)	Mitigation needed for 100% impact to CAVSARP Complex	Habitat in CAVSARP Complex that cannot be mitigated within the Planning Area
CFPO over-wintering, LLNB, and WYBC	0	0	0
TSS	585	1,754	453
GS	85	171	0
CFPO dispersal	239	478	0
PTBB	2	2	0

5.3.4 Restoration/Enhancement Activities

The following sections detail restoration and enhancement activities that may be needed to supplement the habitat preservation requirements outlined above.

HABITAT RESTORATION

Lesser Long-Nosed Bat

[Note: Waiting for a response to questions posed to USFWS staff]

Cactus Ferruginous Pygmy-Owl

[Note: Waiting for a response to questions posed to USFWS staff]

Tucson Shovel-Nosed Snake

According to Dr. Phil Rosen:

> *Although we lack a full, clear understanding of its habitat requirements in its range on the transition of Arizona Upland to Lower Colorado Valley Sonoran Desertscrub from Florence to Casa Grande to Marana, there is enough evidence to indicate that productive, mesquite-, catclaw acacia-, blue paloverde-, and creosotebush-dominated areas with sandy loam to very sandy soils are optimal. Productive swales and stabilized former dunes or sand lenses are characteristic formations that appear to enhance habitat suitability for the Tucson Shovelnosed Snake (2008).*

Thus, habitat restoration and enhancement should focus on recovery of natural vegetation where woody vegetation, additional to mesquite and desert broom, can grow on loamy soils. For the Brawley Wash system, this would also involve removal of drainage / channelization structures that preclude sheet-flow, braiding, and sediment deposition (sand and fine sandy loam) (Rosen 2008).

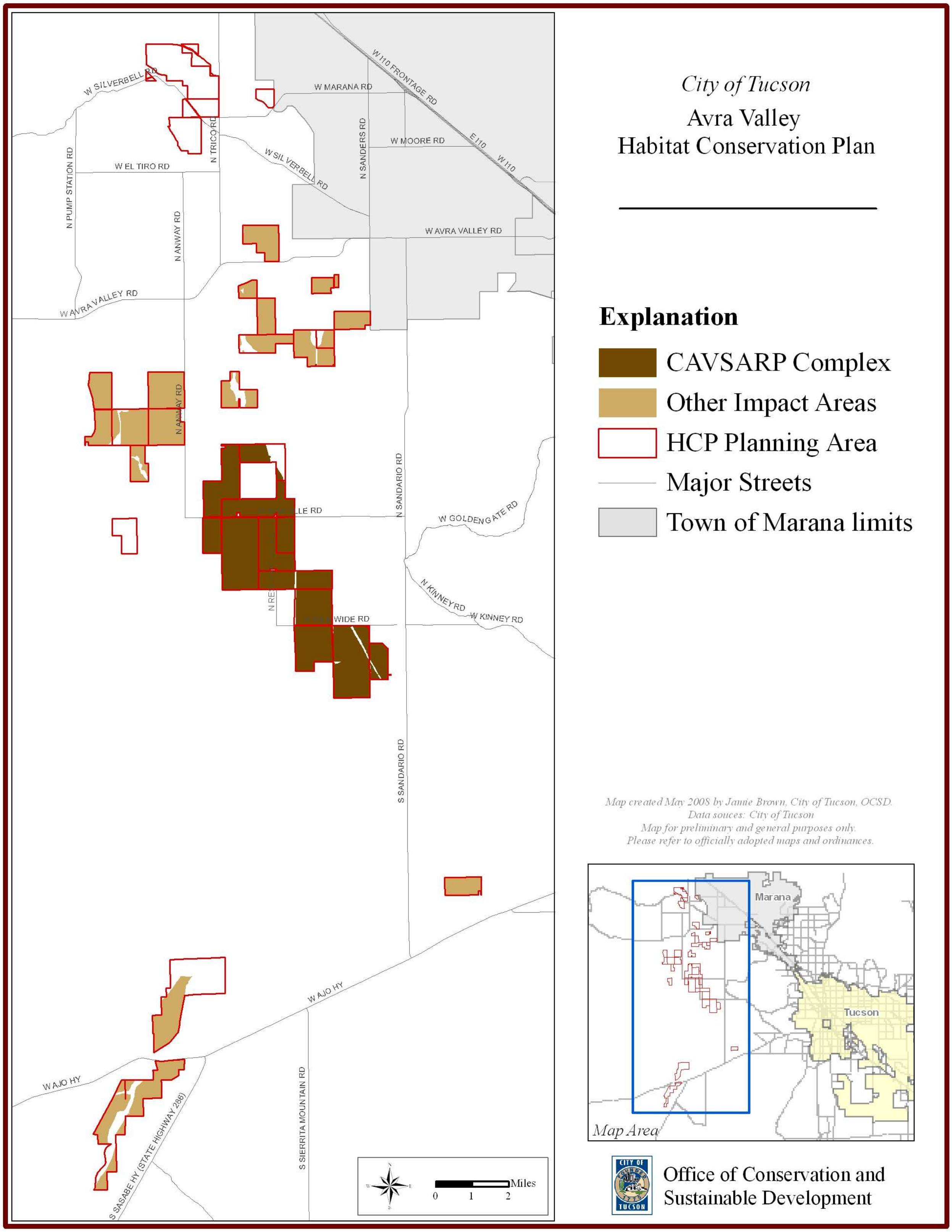

Figure 5.3-5. Impact Areas, including the CAVSARP Complex.

In addition, Dr. Rosen recommends that:

> *Processes that enhance the accumulation of patches of sand and soft soil should be favored:*
>
> - *Creosotebush, mesquite-shrub complexes, and other shrubs that trap accumulations of wind-blow sand around themselves should be encouraged, and seeding of creosotebush in suitable areas of re-vegetating farmland could be considered.*
>
> - *Digging animals that have significant effects on soil should be conserved, particularly large ones like the Bannertail Kangeroo Rat (which apparently occurs on Cactus Avra Farm), Merriam's Kangaroo Rat, and several smaller species of pocket mice in the kangaroo rat family (Heteromyidae*) (2008)

Ground Snake

Since the species lives in floodplain bottoms that support mesquite bosques or open stands of mesquites, habitat enhancement and restoration should focus on preserving existing mesquite woodlands. The lands connected to the Brawley Wash are not as suitable because channelization and drainage have left behind hard adobe soils. Thus, there is not enough pooling and too much erosion to be suitable habitat without restoring the sheet-flooding regimes. In contrast, the Blanco Wash on the west side of Avra Valley maintains the sheet flow and silty-sandy, braided wash bed necessary for the species, making these lands more suitable for the species. (Rosen 2008). Thus, restoration and enhancement on lands as part of the Brawley Wash system should focus on removal of drainage / channelization structures that prevent the deposition of sandy and silty sediments. Debris, as long as it is non-toxic, should remain on restoration or enhancement sites as items such as dead trees, concrete, boards, and pieces of sheet metal enhance the habitat for the snake and its prey (Rosen 2008).

Pale Townsend's Big-Eared Bat

Restoration of lands should emphasize the importance of water to the species for drinking and enhancing foraging resources. As the species is primarily a moth specialist, it feeds in the open along edge habitats such as streams and intermittent streams as well as along pastures, crops, and native vegetation. The species tends to avoid open land such as grazed pasture. (R. Sidner, University of Arizona, pers. com). Restoration and enhancement should focus on mimicking the foraging habitat characteristics described above. This may include installation of riparian plant species that can be supported by the site's depth to groundwater and flow regime. Prior to restoration or enhancement, such sites may not currently support native vegetation due to competition from exotic invasive species, lack of seed sources because of prior land uses, etc.

Yellow Billed Cuckoo

[Note: Waiting for a response to questions posed to USFWS staff]

CORRIDORS

Cactus Ferruginous Pygmy-Owl

[Note: Waiting for a response to questions posed to USFWS staff]

BURROWING OWL MANAGEMENT AREAS (BOMAS)

Conservation Strategy 2*: Develop and maintain Burrowing Owl Management Areas (BOMAs) to mitigate for impacted suitable burrowing owl habitat.*

The City will establish as many as four BOMAs during the permit period. Given that the total amount of potential burrowing owl habitat within the planning area is 5,167 acres, one BOMA will be developed for each 1,292 acres of project impact. Each BOMA must be in place prior to the occurrence of the 1,292 acres of impact that it is intended to mitigate. Once more than 1,292 acres of impact to burrowing owl habitat occurs within the HCP planning area, another BOMA must be established for the second 1,292 acres of impact.

The City will develop a management plan to maintain and/or create suitable nesting and foraging opportunities for burrowing owls in the BOMAs within 1 year of establishment of the first BOMA. The management plan will be amended to encompass management of the second, third, and fourth BOMAs, as these areas are needed, in order to create a comprehensive and integrated management plan of the four areas. If artificial nesting structures are used, the City will install up to three structures per acre in each BOMA. Burrowing owls will be allowed to independently colonize any of the BOMAs.

Barring unforeseen circumstance or significant changes in how lands are prioritized, the farms that compose the Santa Cruz River Block in the northernmost part of the HCP planning area, will most likely serve as sites for the BOMAs. These farms have suitable dispersal habitat given their proximity to the Santa Cruz River. In addition, the presence of “open, treeless areas with low vegetation density and presence of fossorial mammals” (AGFD 2007) provide good nesting habitat for the burrowing owls. Finally, the North Simpson Farm, which is part of this Block of farms, has already hosted the successful release of burrowing owls. Figure 5.3-6 shows the burrowing owl habitat throughout the habitat and highlights the Santa Cruz River Block.

The City will ensure the long-term conservation of the BOMAs through conservation easement or another mechanism approved by the USFWS. Regardless of whether the BOMAs are established within the Santa Cruz River Block or within suitable burrowing owl habitat elsewhere in the HCP planning area, the specific location of BOMAs will be determined through consultation with USFWS and AGFD. In do so, locations of any BOMAs developed by the County or Marana, as well as any known hack sites for burrowing owls will be considered.

The BOMAs will meet the following criteria, developed by the Burrowing Owl Working Group, unless otherwise approved by the USFWS:

- *BOMA’s should consist of suitable nesting habitat (i.e., open, treeless areas with low vegetation density and presence of fossorial mammals).*
- *Identifying the ideal size for a BOMA will entail adaptive management (see BOMA Monitoring below). As a starting pint, BOMA’s should consist of ≥12ha of land.*
- *BOMA’s should be established away from heavily used roadways. Vehicle related mortality is considered a signficant threat to burrowing owls (Konrad and Gilmer 1984)*

- *BOMA's should be located such that dispersal habitat exists nearby (e.g., additional nesting habitat and major washes or river corridors such as the Santa Cruz or Gila Rivers) (AGFD 2007).*

The City will obtain written approval from the USFWS on the BOMAs.

5.3.5 Minimize Direct Adverse Impacts

Conservation Strategy 3*: The City will implement measures to minimize the likelihood of direct adverse effects (injury or mortality) to all species covered under this HCP.*

Lesser Long-nosed Bat

Due to the difficulty in tracking foraging bats and their habitat use, species-specific surveys will have little value. Given the nocturnal foraging habits of the species, direct adverse effects from construction activities—which generally occur during the day—are unlikely. Moreover, the transitory use of foraging habitat within the planning area reduces the likelihood of direct injury or mortality.

Cactus Ferruginous Pygmy-Owl

Dispersing pygmy-owls may only be present on a property for a few hours to a couple of days. Surveys for owls during the dispersal season are unlikely to result in pygmy-owl detections, even if owls are using the area for dispersal. To minimize the potential for adverse impacts to dispersing pygmy-owls, therefore, suitable habitat will be used as a trigger rather than survey detections of birds. Construction activities in areas determined to support or potentially support over-wintering habitat for pygmy-owl will be timed, when possible, to avoid ground disturbance activities during the dispersal season (mid-July to December). When construction during the dispersal season is necessary, construction activities will avoid mapped dispersal habitat areas to the extent possible and will limit, to the greatest extent possible, ground disturbance activities from one hour before dusk until one hour after dawn.

Burrowing Owl

For construction activities in areas determined to support or potentially support burrowing owls, surveys for burrowing owls will be conducted within 30 days of initiation of construction activities. If burrowing owls are found, they will be passively evicted before initiation of construction activities. If eviction of owls during the breeding season is necessary, the project proponent will coordinate with the USFWS and AGFD to evict the owls in a manner that minimizes potential harm to adults and nestlings.
The City will erect and maintain wildlife-friendly fences around all properties in the planning area with existing, enhanced, or restored suitable habitat to prevent unauthorized grazing and use of Off Road Vehicles (ORVs) in these areas.

Tucson Shovel-Nosed Snake

Due to the difficulty in detecting snakes, species-specific surveys will have little value. Where construction is planned to occur, attempts to save individual animals remain infeasible for secretive, small animals such as snakes (Rosen 2008).

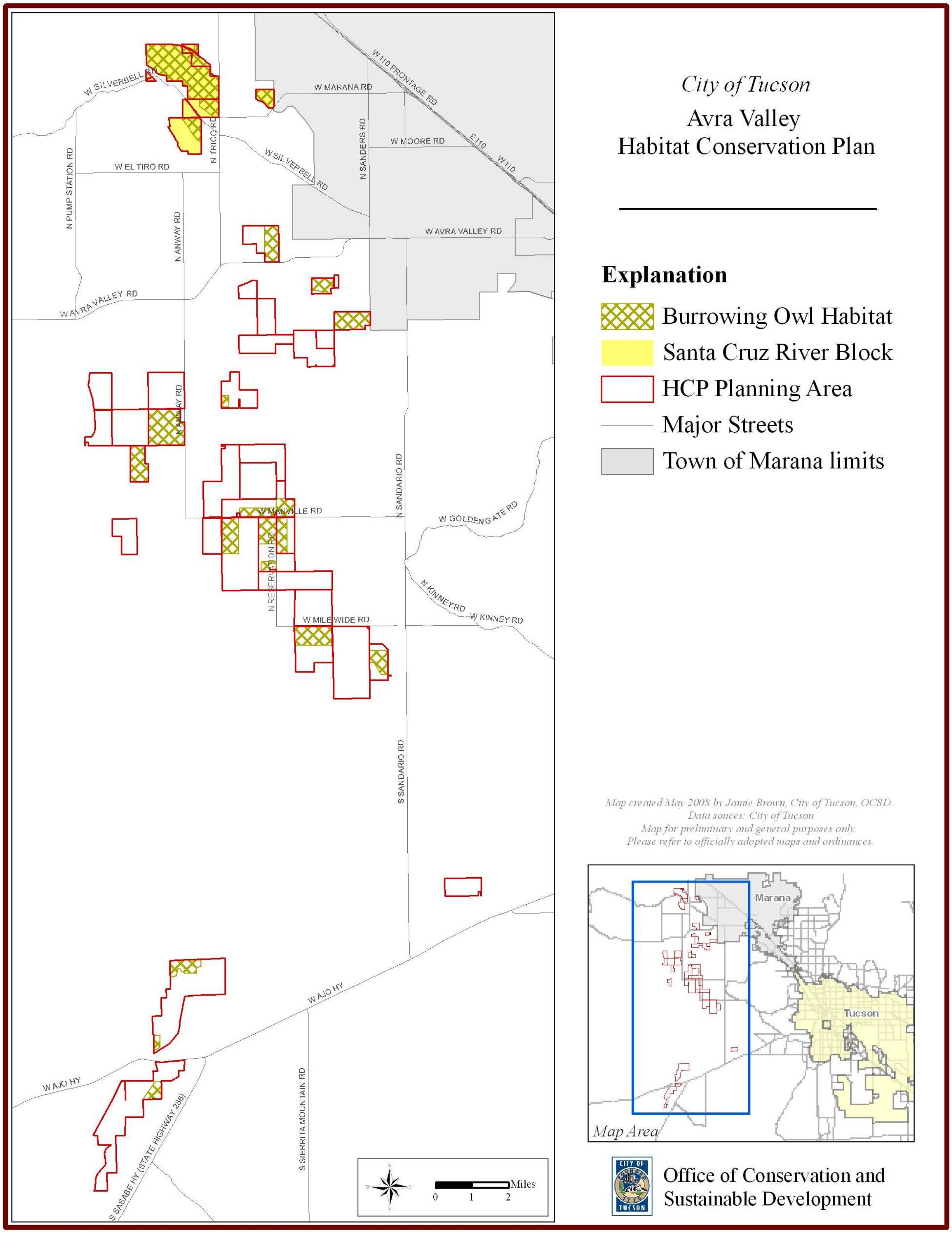

Figure 5.3-6. Burrowing Owl Habitat and the Santa Cruz River Block

Ground Snake

Due to the difficulty in detecting snakes, species-specific surveys will have little value. Where construction is planned to occur, attempts to save individual animals remain infeasible for secretive, small animals such as snakes (Rosen 2008).

Pale Townsend's Big-Eared Bat

Due to the difficulty in tracking foraging bats and their habitat use, species-specific surveys will have little value. The transitory use of foraging habitat within the planning area reduces the likelihood of direct injury or mortality.

Western Yellow Billed Cuckoo

Check with Tucson Audubon Society regarding annual bird counts at Simpson Farm North to determine whether cuckoo are using the site. Avoid construction activities at Simpson Farm North during the breeding season during any year in which cuckoos were detected at the site or where cuckoos were detected in the preceding year.

5.3.6 Promote Integrated, Regional Conservation Planning

The City will provide neighboring jurisdictions with information about the City's conservation program in order to encourage implementation of compatible conservation measures by these jurisdictions. The City will coordinate with local, state, and federal jurisdictions and private landowners to control exotic plant species and minimize the potential for wildfire within Avra Valley.

The goal of this measure is to work towards consistent outcomes across jurisdictions and, ultimately, to preserve a regional landscape that supports the long-term persistence of the City-covered species within Pima County.

5.3.7 Phased Implementation

Given the uncertainty regarding the implementation of the covered activities, including the size, scope, location, and timing of these projects, it is necessary to implement the above conservation strategies in a phased manner.

The bulk of the conservation program depends on the eventual protection of some suitable habitat as mitigation for future impacts for other suitable habitat that will be impacted by the development of projects covered in this HCP. Phasing the legal dedication of these lands through conservation easement to coincide with the implementation of projects will provide the necessary flexibility for the City to site future projects. The value of the mitigation areas depends on the continued suitability of these areas as habitat for the covered species.

Conservation Strategy 4*: Mitigation areas will be managed to maintain the quality of suitable habitat for all species covered under this HCP.*

WILDLIFE-FRIENDLY FENCING AND SITE SECURITY

The City will erect (where not already present) and maintain wildlife-friendly fences around all properties in Avra Valley with existing, enhanced, or restored suitable habitat, in order to prevent unauthorized grazing and the use of Off Road Vehicles (ORVs) in these areas. This should help minimize: damage to existing vegetation; the potential for wash degradation (e.g., erosion, incision, headcutting); disturbance to covered species due to noise and proximity of humans; and the potential for introduction of toxic materials, fire, or other environmentally damaging factors.

The City is currently monitoring the fence-lines within the Avra Valley planning area, driving by once a week. This is being done in an effort to check for illegal dumping and other encroachments. The City will add airplane cable when necessary wherever frequent fence cutting occurs in an attempt to limit illegal activity within City-owned Avra Valley parcels. This management approach is necessary in order to minimize the potential negative impacts that these illegal activities may have on targeted species and/or their habitats within the planning area.

The City will continue its on-going effort of surveying, fencing, and posting all farms as “No Trespassing” zones. All the HCP target species are expected to benefit from these “No trespassing” zones due to the anticipated decrease in ORV use and other human disturbances noted above.

INVASIVE SPECIES REMOVAL

Buffelgrass (along with many other non-native species) is considered to have negative impacts on native vegetation. Areas of dense buffelgrass cover pose a fire hazard that is not typical of the normal fire regime of the Avra Valley planning area. Non-native vegetation can also out-compete native vegetation species for resources. These and various other impacts could lead to negative effects on HCP target species. The City has therefore decided that one of the necessary HCP management programs is to effectively eradicate invasive species wherever possible and feasible. The City has already developed a buffelgrass removal plan for test farms within the Avra Valley planning area (see tables 5.3-8 through 5.3-13 and figure 5.3-7 for details). The City will expand the areas managed for buffelgrass removal based on this initial work. The City is in the process of mowing areas infested with Russian thistle (commonly referred to as tumbleweed).

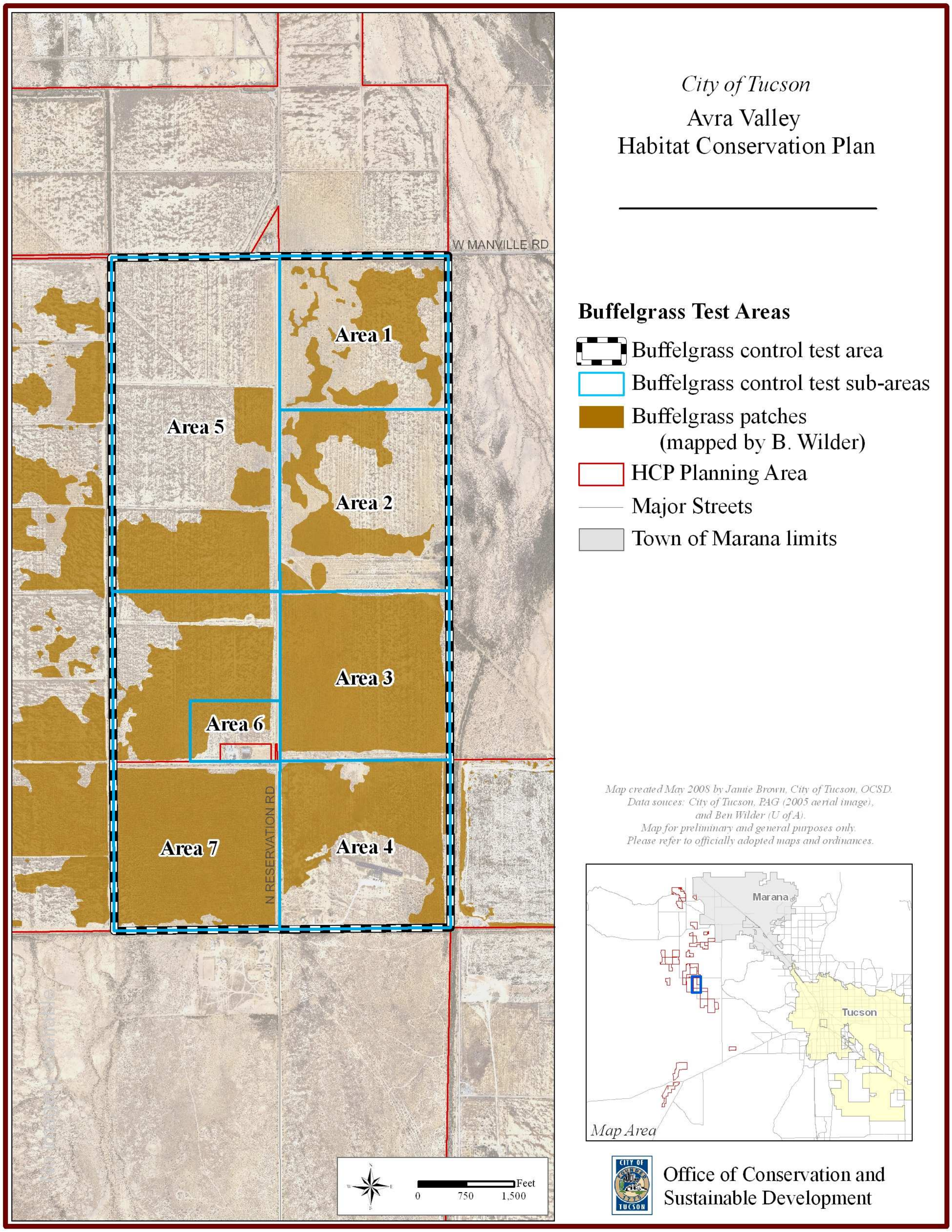

Figure 5.3-7. City of Tucson buffelgrass control test area and sub-areas

Table 5.3-8. Buffelgrass Treatment Activities within Test Sub-area 1 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Fencing	6/29/2002	1-7			Once cattle no longer had access to graze, buffelgrass quickly invaded.
Controlled burn	3/29/2007	1	The burn was patchy due to shifting winds. The east side of Area 1 received less fire	A 9.14-m perimeter was bladed to create a firebreak.	Approximately 75% of the area burned.
Herbicide applied via tractor	5/1/2007 through 5/10/2007	1	Approximately 32.4 ha sprayed	Used 75.7 liters of Kleenup® diluted per 0.40 ha sprayed. 0.44 liters of unmixed product per 0.40 ha.	
Herbicide applied via tractor	7/31/2007 through 8/8/2007	1	Second round of herbicide application. The west side of area was not sprayed because it contained mostly native grasses wit isolated patches of buffelgrass, pigweed and tumbleweed.	Used 2.5% Kleenup® solution; approximately 2.07 – 2.23 liters per 0.40 ha; 69.48 liters of mixed chemical per 0.40 ha.	Pigweed still growing. This was the first area sprayed after the monsoon started, when buffelgrass was approx. 0.46 m. high. The pigweed was not mature at this time. New growth of buffelgrass appeared after the application. Patchy areas of buffelgrass dieback.

Table 5.3-9. Buffelgrass Treatment Activities within Test Sub-area 2 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Controlled burn	3/29/2007	2	The burn was patchy due to shifting winds. The east side of Area 2 received less fire.	A 9.14-m perimeter was bladed to create a firebreak.	Approximately 50% of this area burned.
Herbicide applied via tractor	8/9/2007 through 8/17/2007	2	First round of herbicide application.	Used 2.5% Kleenup® solution; approximately 2.07 liters per 0.40 ha	

Table 5.3-10. Buffelgrass Treatment Activities within Test Sub-area 3 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Controlled burn	3/29/2007	3	The burn was patchy due to shifting winds. The east side of Area 3 received less fire. The burn was increasingly patchy at the south end of Area 3.	A 9.14-m perimeter was bladed to create a firebreak.	Approximately 25% of this area burned.
Herbicide applied via tractor	8/20/2007 through 8/27/2007	3		Used 2.5% Kleenup® solution; approximately 2.07 liters per 0.40 ha. Raised the sprayer booms[1] because the buffelgrass was too high to be sprayed with the booms.	

[1]Sprayer booms are mounted on the back of the tank that contains the chemical, on the tractor. The booms are stiff hoses that distribute the chemical. The booms can be lowered to spray short vegetation, or raised for higher vegetation

Table 5.3-11. Buffelgrass Treatment Activities within Test Sub-area 4 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Controlled burn	3/29/2007	4	The burn was patchy due to shifting winds. The east side of Area 4 received less fire. The burn was increasingly patchy at the south end of Area 4.	A 9.14-m perimeter was bladed to create a firebreak together with a 9.14-m perimeter surrounding Tucson International Modelplex Park Association (TIMPA).	Approximately 25% of this area burned.
Herbicide applied via tractor	8/24/2007 through 9/5/2007	4		Used 2.5% Kleenup® solution; approximately 2.07 liters per 0.40 ha. Sprayer booms raised[1]	

[1]Sprayer booms are mounted on the back of the tank that contains the chemical, on the tractor. The booms are stiff hoses that distribute the chemical. The booms can be lowered to spray short vegetation, or raised for higher vegetation

Table 5.3-12. Buffelgrass Treatment Activities within Test Sub-area 5 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Mowed	8/2006	5		A 9.14-m perimeter was bladed to the north of the farmhouse fence to create a firebreak	
Mowed	1/2007	5			
Herbicide applied via airplane	9/2/2007 through 9/4/2007	5	Aerial spray notes: Area to be sprayed is programmed into the flight plan using a GPS. Plane holds 757 liters of diluted solution per load. Able to spray slightly more than 2 passes each load. Sprayed for 10 hours. Sprayed a little less than 242.8 ha	5% Kleenup® solution. For comparison purposes, plane averages 18.9 liters of diluted solution per 0.40 ha, tractor averages 64.3 liters of diluted solution per 0.40 ha.	

Table 5.3-13. Buffelgrass Treatment Activities within Test Sub-area 6 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Bladed	2/27/2006	6	Area surrounding the Bratton Farm.	A 61-m perimeter was bladed to create a firebreak.	
Herbicide applied via tractor	1/2007	6	Area surrounding the Bratton Farm	Use 2.5% Kleenup® solution; approximately 2.07 liters per 0.40 ha. Sprayer booms raised[1].	

Table 5.3-14. Buffelgrass Treatment Activities within Test Sub-area 7 in Avra Valley, Compiled Sept. 2007.

Treatment	Date	Sub-area	Comments	Details	Results
Mowed	7/2007	7	Approx. 45.7 m in Area 7 were accidentally mowed parallel to Reservation Rd. on the west side. Area 7 otherwise has not been treated to date. Burrowing owls appear to move to different burrows in Area 7. Burrows, perhaps occupied by owls, parallel the eastern fence line and western berm.		
Herbicide applied via airplane	9/2/2007 through 9/4/2007	7	Aerial spray notes: Area to be sprayed is programmed into the flight plan using a GPS. Plane holds 757 liters of diluted solution per load. Able to spray slightly more than 2 passes each load. Sprayed for 10 hours. Sprayed a little less than 242.8 ha	5% Kleenup® solution. For comparison purposes, plane averages 18.9 liters of diluted solution per 0.40 ha, tractor averages 64.3 liters of diluted solution per 0.40 ha.	

As part of the buffelgrass control and eradication efforts, the City has partnered with the University of Arizona and Saguaro National Park on a study of buffelgrass and fire. The study involves a controlled burn of 160 acres of buffelgrass infested City-owned land within the Avra Valley planning area. Measurements wild record fire intensity and spread rate and results from collaborative studies such as this will provide the City with additional information on how best to manage buffelgrass with the planning area.

Since invasive species are expected to have potential negative impacts on all of the covered species, these management actions are expected to benefit each of the species.

LAND MANAGEMENT ACTIVITIES

The City currently has reseeding trials planned for small portions of the buffelgrass treatment areas. Some reseeding around recharge basins has already occurred as well. The City will expand on this effort as needed to replace invasive species covered removed as a result of activities outlined in Section 5.3.7.2. Tucson Audubon Society restoration at the North Simpson site includes revegetation and seeding trials in combination with rainwater harvesting. These efforts will serve as small-scale trials and models for the City to follow at other Avra Valley sites. All of the HCP target species are expected to benefit from these restoration efforts.

Based on the results observed at the North Simpson site, basic restoration strategies will include the creation of swales, planting and seeding of native vegetation, erosion control, and invasive species removal, as needed. The employment of these strategies will be determined on a site-by-site basis according to planned land use and existing site conditions.

Section 6

MONITORING AND ADAPTIVE MANAGEMENT

Monitoring the effectivenes of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its 5-Point Policy Guidance (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

- Compliance monitoring – *Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.*
- Effectiveness monitoring – *Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.*

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring of conservation measures to be implemented as mitigation for potential impacts of City development activities summarized in Section 2. If any projects described in Section 2 are carried out, the City will implement those conservation measures required to mitigate the specific impacts of those projects. If none of the potential projects summarized in Section 2 are implemented, the City will continue with current land management practices.

6.1 Compliance Monitoring and Reporting

If City development activities summarized in Section 2 are implemented, then compliance monitoring and reporting will be accomplished through the following:

- The City will submit, to the USFWS, annual reports documenting progress toward and completion of the conservation commitments.
- The City will require that all City development plans within the Avra Valley planning area contain a narrative discussion documenting compliance with the conservation measures that will be outlined and approved in the final HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance. The submittal shall outline monitoring programs to document compliance with the conservation measures approved in the final HCP.

6.2 Effectiveness Monitoring and Reporting

If any of the activities summarized in Section 2 are carried out, thus putting related conservation measures into effect, then the effectiveness of the conservation program will be measured in terms of:

- The lack of “take” for each covered species (“take” is defined by USFWS as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct), direct or indirect, as a result of permitted activities within the Avra Valley planning area.
- The amount, configuration, and quality of habitat existing within the planning area at any point in time during the implementation of HCP covered activities.

As noted above, effectiveness monitoring focuses on whether the HCP measures are achieving the biological goals and objectives for each species. The framework for effectiveness monitoring and adaptive management consists of a series of benchmarks used to assess the progress toward the overall goal. Adjustments in management are made if these benchmarks are not achieved.

6.2.1 Species-Specific Surveys and Monitoring

For some species, surveys may be required to document their response to implementation of the conservation measures in the HCP. For reasons related to cost-effectiveness and consistency, these surveys will be coordinated with present and future efforts conducted by Pima County and/or the Town of Marana, AGFD, USFWS, and other land or wildlife management agencies. Within the Avra Valley planning area, the City is expecting to conduct species-specific surveys only for the western burrowing owl.

For other species, proxy measures may be more appropriate for measuring response to HCP measures. For example, the diversity and abundance of a species' prey base may be a less costly and/or more accurate measure of the effects of the HCP implementation than surveys for the species itself. This type of survey approach may be beneficial to monitoring efforts for cactus ferruginous pygmy-owl, pale Townsend's big-eared bat, ground snake, and Tucson shovel-nosed snake. In addition to species-specific surveys for the western burrowing owl, the City is also proposing certain species-specific monitoring approaches for the other species listed below.

CACTUS FERRUGINOUS PYGMY-OWL

The Avra Valley planning area is thought to be important as a CFPO dispersal corridor, however, as CFPO are not known to breed in the area, species-specific surveys are not considered to be an effective measure of HCP success with respect to this species. The City will also request written confirmation from USFWS regarding the location of any pygmy-owls detected in the vicinity of Avra Valley so that they can be monitored to determine if they disperse or over-winter within the planning area.

The main goal of the CFPO conservation program is to minimize permanent impacts to suitable pygmy-owl dispersal, over-wintering, and, if available, breeding habitat within the Avra Valley planning area, as loss and fragmentation of these habitats is thought to be the main cause of pygmy-owl declines observed throughout the region. The CFPO requires cavities for nest sites, suitable foraging and roosting sites for over-wintering use, and vegetation diversity and structure for dispersal. Successful implementation of the conservation program will result in the preservation and enhancement of vegetation and prey diversity and abundance, as the pygmy-owl is known to consume a diverse array of prey species and prefers high vegetation density and multiple vegetation layers. This includes the management of invasive species, which decrease vegetation and prey diversity. To these ends, the City will conduct periodic monitoring of these habitat areas through the use of photo interpretation and other general habitat monitoring efforts, in an attempt to recognize any potential negative impacts over time. The City will also monitor and assess the potential for CFPO to occur in the planning area through other habitat monitoring efforts outlined in 6.2.2.

WESTERN BURROWING OWL

Loss of breeding habitat is considered to be the most critically important threat to burrowing owls in Arizona. The burrowing owl prefers low-density vegetation surrounding burrows. However, some structural diversity is necessary to support prey diversity and abundance, to serve as lookout perches near burrows, and to provide escape cover. Natural burrows may also be limiting in some areas of otherwise suitable habitat. As Burrowing Owl Management Areas (BOMAs) are established (see Chapter 5), the

City will conduct periodic surveys (every 3 years), during both the breeding and over-wintering seasons, to determine the presence, numbers, and locations of burrowing owls, in order to compare numbers with baseline surveys of the Avra Valley planning area initially conducted by AGFD. The focus of these efforts will initially be on the winter surveys, as breeding was not observed during AGFD surveys conducted in 2006 and breeding is not known to occur currently within the planning area. However, if at any time during the period covered by this HCP the City becomes aware that a surge of breeding activity has been observed within the planning area, this will necessitate regular monitoring of potential breeding habitat as well. Pre-construction surveys will be required on all City projects to prevent injury to or death of any burrowing owls that may be present during vegetation clearing or any other ground disturbance activities. The City will determine if owls are returning to existing areas or if they are occupying new areas within the planning area, and will compare the Avra Valley populations to those outside of the planning area in order to better evaluate regional population declines of BUOW not directly attributable to the implementation of covered activities in Avra Valley.

Along with the monitoring efforts outlined above for BUOW, the City will implement the following additional measures within BOMAs: 1) band all burrowing owls present within each of the BOMAs in order to monitor occupancy, health, reproductive success, nesting status, etc. for each of the BOMA populations; and 2) conduct periodic monitoring of burrows to determine occupancy, reproductive success, nesting status, etc. These efforts are necessary in order to document the success of each BOMA.

GROUND SNAKE

The loss of habitat resulting from agricultural and urban development is regarded as the most serious historic threat to this species, while the ability to disperse has been compromised by roads, developed areas, irrigation and drainage ditches, and impacted soils. The loss and fragmentation of habitat, along with an increase of non-native vegetation and a decrease of native vegetation, has led to decreased prey diversity, increased fire potential, and changes in soil characteristics. The City will conduct periodic monitoring of these habitat areas through the use of photo interpretation and other general habitat monitoring efforts, in an attempt to recognize any potential negative impacts over time.

As ground snakes are not known to occur in the Avra Valley planning area, species-specific surveys are not considered to be an effective or productive use of resources. The City may instead decide to monitor the diversity and abundance of the prey base as a more accurate measure of the effects of the HCP implementation on the ground snake. However, if any ground snakes are uncovered during earth-moving operations related to Tucson Water development projects, then the City will change its management strategy as appropriate. This may include the use of species-specific surveys.

TUCSON SHOVEL-NOSED SNAKE

The loss of habitat resulting from agricultural and urban development is regarded as the most serious historic threat to this species, while the ability to disperse has been compromised by roads, developed areas, irrigation and drainage ditches, and impacted soils. The loss and fragmentation of habitat, along with an increase of non-native vegetation and a decrease of native vegetation, has led to decreased prey diversity, increased fire potential, and changes in soil characteristics. The City will conduct periodic monitoring of these habitat areas through the use of photo interpretation and other general habitat monitoring efforts, in an attempt to recognize any potential negative impacts over time.

As Tucson shovel-nosed snakes are not known to occur in the Avra Valley planning area, species-specific surveys are not considered to be an effective or productive use of resources. The City may instead decide to monitor the diversity and abundance of the prey base as a more accurate measure of the effects of the HCP implementation on the Tucson shovel-nosed snake. However, if any Tucson shovel-nosed snakes are uncovered during earth-moving operations related to Tucson Water development projects, then the City will change its management strategy as appropriate. This may include the use of species-specific surveys.

PALE TOWNSEND'S BIG-EARED BAT

The availability of roost sites, mainly caves and mines but also including bridges and buildings to a lesser degree, is the single most limiting factor in an area's suitability for the pale Townsend's big-eared bat. According to the AGFD Heritage Data Management System (AGFD 2003b), there are no known roost sites for this species available within the Avra Valley planning area. Given the low elevations and relatively flat topography of the planning area, there is also little or no potential for undocumented roost sites to be present. However, as bats have recently been found roosting in an erosion cave associated with soil-piping in Cienega Creek, the City conducted surveys of Brawley Wash and the Santa Cruz River within the planning area in December 2006 for any caves of this type, in order to evaluate the potential that this species could roost within the planning area. These surveys confirmed that the availability of roost sites within the planning area is not likely. The species may forage over lands within the planning area due to its proximity to known roost sites in the Rincon, Santa Rita, and Slate mountain ranges.

Species-specific surveys for PTBB are expected to be difficult and ineffective within the Avra Valley planning area, so the City will determine if surveys of vegetation, invertebrates and/or land conditions would be useful in assessing the potential for these bats to forage in the planning area. As PTBB usually forage for moths near open water, periodic surveys of open water areas may be an effective tool in assessing the probability that this species may occur in the planning area. If any potential roosts are encountered at any time during the implementation of this HCP, the City will create a management plan to preserve these sites. The City also anticipates monitoring and assessing the potential for big-eared bats to occur in the planning area through other habitat monitoring efforts outlined in 6.2.2.

WESTERN YELLOW-BILLED CUCKOO

The loss of riparian habitat, and the subsequent decrease of thermal cover and prey species, is thought to be the primary threat to the yellow-billed cuckoo, as it breeds in large blocks of dense riparian vegetation with tall trees and a well developed mid-story. The City will conduct periodic monitoring of these habitat areas through the use of photo interpretation and other general habitat monitoring efforts, in an attempt to recognize any potential negative impacts over time.

The City will defer to on-going avian surveys already being conducted by Tucson Audubon Society at the North Simpson property. These surveys are expected to effectively record the presence of WYBC in the Avra Valley planning area, as the North Simpson site contains much of the potentially suitable habitat available for this species in the planning area. The City also anticipates monitoring and assessing the potential for WYBC to occur in the planning area through other habitat monitoring efforts outlined in 6.2.2.

6.2.2 Habitat Monitoring

The City plans on utilizing a variety of general habitat monitoring techniques to determine the success of current management actions and to alter management techniques when necessary. These monitoring techniques will help the City to meet the biological goals and objectives for all of the HCP target species, including the Tucson shovel-nosed snake and the ground snake, for which there currently are no species-specific monitoring objectives outlined.

VEGETATION SURVEYS

Changes in vegetation density and composition may be used as a measure of a species' response to implementation of the conservation measures outlined in the HCP. This would be accomplished through the use of remote sensing to detect changes in the density, structure, and/or diversity of woody, and possibly, non-woody plants in selected areas. The City will utilize the latest Pima Association of Government (PAG) one-foot resolution aerial photography of the planning area as a viable indicator of baseline conditions. The City will also design some kind of sample frame for monitoring particular sites for vegetation changes.

There is typically an element of ground-truthing necessary when implementing a remote sensing monitoring program, however, it is expected that monitoring vegetation through remote sensing in this manner should require minimal ground-truthing while documenting successful achievement of the biological goals and objectives for target species. Over time, this approach to monitoring may prove useful for monitoring the response of yellow-billed cuckoo, burrowing owl, and pygmy-owl to implementation of the conservation measures.

PHOTO-MONITORING

The City has established multiple photo-points at each farm within the Avra Valley planning area, and will now determine at what frequency these photo-monitoring efforts will occur based on discussions with the TAC. These photo-points are potentially useful for targeted HCP species because they will allow the City to assess general habitat conditions over time (e.g., changes in vegetation density, channel stability, evidence of sheet flow, illegal activities) at each parcel within the planning area.

BASELINE SITE CONDITIONS

After an initial review of past reports and other available information, the City has structured its initial management approach for targeted species within the Avra Valley planning area according to existing conditions, including vegetation, surrounding land uses, presence of wells, etc. With this baseline, the City can effectively modify its management approach, whenever it may become necessary, in order to continue meeting the biological goals and objectives established for each species.

CHANGE SITE CONDITIONS

The City will periodically reassess certain selected site parameters in order to verify that the conditions at future reserve areas are stable or improving, and that the conditions of other Avra Valley planning area sites are stable. This will be particularly useful with regards to monitoring the proliferation of nonnative species such as buffelgrass. The City will use a combination of site inspections, ground-level photo-monitoring efforts, and satellite imagery, as needed, to conduct these periodic assessments. The City will determine the frequency and techniques necessary to conduct these monitoring efforts based on the initial conditions and the projected future uses of these sites. Future reserve lands and potential mitigation sites will be the primary focus of these monitoring efforts.

6.2.3 Effectiveness Assessment and Adaptive Management Program

The results of surveys and monitoring efforts conducted by the City and other agencies (such as AGFD) will be used to meet the species-specific biological goals and objectives outlined in the Conservation Programs in Section 5. This will be achieved by establishing a set of benchmarks and procedures for evaluating the success of each conservation action relative to these benchmarks.

Benchmarks will establish the results (e.g., population size within the planning area, number of offspring produced per year, amount of habitat protected, etc.) that are expected within a particular time interval (e.g., 5 years, 10 years, etc.) after implementation of a specific conservation action. Benchmarks will be developed for each action identified in the HCP conservation program (Section 5). General and specific benchmarks are outlined below.

The conservation strategies will be considered successful if the following benchmarks are achieved:

BENCHMARK 1 (FOR ALL SPECIES)

The number of occupied territories for each species has either increased or remained the same annually for x number of years.

BENCHMARK 2 (FOR ALL SPECIES)

The amount of potential suitable habitat has either increased or remained the same annually for x number of years.

BENCHMARK 3 (FOR BOMAS)

Within 5 years of establishing a BOMA and implementing enhancement actions, the BOMA will be considered successful if:

- At least one burrowing owl pair has occupied the BOMA during the breeding season in at least one year
- Burrowing owls occupying the BOMA have successfully bred (i.e. produced at least one fledgling) in at least one year

BENCHMARK 4 (FOR BOMAS)

Within 5 years of achieving Benchmark 3, the BOMA will be considered successful if:

- Multiple pairs of burrowing owls occupy the BOMA during the breeding season in at least 50 percent of the years
- At least 50 percent of the nesting pairs in the BOMAs successfully fledged young

6.2.4 On-Going Monitoring and Adaptive Management

Overall, the City intends to minimize permanent impacts to suitable habitat available within the Avra Valley planning area for all of the HCP target species. If at any point during the implementation of any permit activities negative impacts are expected to occur to any of these available suitable habitats, the City will minimize the extent of the impact and mitigate for lost habitat. Possible management options to meet these objectives may include obtaining conservation easements, or through other mechanisms approved by the USFWS.

Following the achievement of all benchmarks, the City will continue to annually monitor the effectiveness of the conservation program. The City will continue to meet with the USFWS and other experts at appropriate intervals to verify continued achievement of the biological goals and objectives. If the annual surveys reveal that the benchmarks are no longer being met, the City, USFWS, and other experts will identify appropriate management adjustments to regain the established goals. Some of the management approaches that will be conducted by the City in order to achieve the goals and objectives of this HCP are outlined below.

BOMA MANAGEMENT

The City will develop a management plan to maintain and/or create suitable nesting and foraging opportunities for burrowing owls in each of the BOMAs. The City will try to ensure the long-term conservation of each BOMA by obtaining conservation easements, or through other mechanisms approved by the USFWS.

If the applicable benchmarks are not successfully met, the City will review the information from the annual surveys, habitat assessments of the BOMAs, and other relevant information, with the USFWS and other burrowing owl experts, in order to identify possible management adjustments that can be made to improve the likelihood of meeting the success criteria. Some of the potential management adjustments that may be made, include

- Changing vegetation management practices
- Coordinating with all agencies involved in order to propose and, possibly, enact ordinances that reduce specific sources of mortality or disturbance
- Installing fencing, or
- Implementing other measures consistent with these types of activities

WILDLIFE-FRIENDLY FENCING AND SITE SECURITY

The City will erect and maintain (where not already present) wildlife-friendly fences around all properties in Avra Valley with existing, enhanced, or restored suitable habitat, in order to prevent unauthorized grazing and the use of ORVs in these areas. This should help minimize: damage to existing vegetation; the potential for wash degradation (e.g., erosion, incision, headcutting); disturbance to owls due to noise and proximity of humans; and the potential for introduction of toxic materials, fire, or other environmentally damaging factors.

The City is currently driving the fence-lines within the Avra Valley planning area once a week. This is being done in an effort to check for illegal dumping and other encroachments. This management approach is necessary in order to minimize the potential negative impacts that these illegal activities may have on targeted species and/or their habitats within the planning area.

The City will continue its on-going effort of surveying, fencing, and posting all farms as “No Trespassing” zones. While conducting these efforts, the City will work with AGFD to document all wildlife species observed. All of the HCP target species are expected to benefit from these “No trespassing” zones due to the anticipated decrease in ORV use and other human disturbances noted above.

INVASIVE SPECIES REMOVAL

Buffelgrass (along with many other non-native species) is considered to have negative impacts on native vegetation. Areas of dense buffelgrass cover pose a fire hazard that is not typical of the normal fire regime of the Avra Valley planning area. Non-native vegetation can also out-compete native vegetation species for resources. These and various other impacts could lead to negative effects on HCP target species. The City has therefore decided that one of the necessary HCP management programs is to effectively eradicate invasive species wherever economically feasible. As discussed in Chapter 5, the City has already developed a buffelgrass removal plan for test farms within the Avra Valley planning area. The City plans to expand the areas managed for buffelgrass removal based on this initial work.

The City is in the process of mowing areas infested with Russian thistle (commonly referred to as tumbleweed). This effort will continue on all City farms, as needed. However, as invasive species are expected to have potential negative impacts on all of the HCP target species, this management action is expected to benefit each of the target species.

CURRENT AND FUTURE LAND MANAGEMENT ACTIVITIES

The City currently has reseeding trials planned for small portions of the buffelgrass treatment areas. The City will expand on this effort as needed. Tucson Audubon Society restoration at the North Simpson site includes revegetation and seeding trials in combination with passive rainwater harvesting (e.g. earthworks such as swales and berms). These efforts will serve as small-scale trials and potential models, which the City can follow at other Avra Valley sites. All of the HCP target species may benefit from these restoration efforts. The potential employment of land management strategies will be determined on a site-by-site basis according to planned land use and existing site conditions.

Section 7

EFFECTS OF IMPLEMENTING THE AVRA VALLEY HCP

The conservation program outlined in this draft HCP is still preliminary. Once the conservation measures (Section 5) and monitoring and adaptive management program (Section 6) have been fully developed, an analysis of the effects of the HCP on the species covered in the HCP is required.

As an interim step, this section provides a summary of the major components of the conservation program and identifies the amount of suitable habitat for each covered species that would be protected if the program were implemented as outlined.

7.1 Conservation Program

The major elements of the conservation program for the Avra Valley planning areas are listed below.

(1) The primary component of the Avra Valley conservation program is the protection of existing natural habitat and critical wildlife corridors.

(2) Opportunities for habitat enhancement and creation will focus on restoration of degraded lands within the critical wildlife corridors, the configuration of recharge basins to provide habitat value, the use of stormwater basins outside of future recharge basins to capture sheetflow and provide areas of habitat, and the creation of Burrowing Owl Management Areas.

(3) Impacts to wildlife and habitats on City-owned properties will be minimized by installing wildlife friendly fencing around these lands and by actively managing invasive species, particularly buffelgrass and tumbleweed, on these properties.

(4) Finally, the City will work with other jurisdictions and agencies to encourage consistency of conservation efforts throughout the region.

Section 8

ALTERNATIVES

SECTION TO BE PREPARED AND INCLUDED IN LATER DRAFT

Section 10 of the Endangered Species Act of 1973 requires an applicant for an incidental take permit to consider and describe “alternative actions to such [proposed] takings” within the Avra Valley HCP planning area.

The City of Tucson will identify and consider several alternatives to the proposed takings.

8.1 Alternative 1: No Action Alternative

8.2 Alternative 2

8.3 Alternative 3

Section 9

PLAN IMPLEMENTATION

SECTION TO BE PREPARED AND INCLUDED IN LATER DRAFT

9.1 Changed and Unforeseen Circumstances

9.2 Costs and Funding

9.2.1 Funding for Minimization and Mitigation Measures

9.2.2 Funding for Changed Circumstances

9.3 Revisions and Amendments

9.3.1 Revisions (Changes to the Plan or Incidental Take Permit)

9.3.2 Amendments to the HCP

9.3.3 Amendments to the Section 10(a)(1)(B) Permit

9.4 Suspension/Revocation

9.5 Renewal of the Section 10(a)(1)(B) Permit

9.6 Permit Transfer

Section 10

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Section 11

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Mr. Julio Betancourt (U.S. Geological Survey)
Mr. Travis Bean (University of Arizona – Desert Lab)
Mr. Tyler Jones (Town of Marana)
Mr. Ben Wilder (University of Arizona Desert Lab)
Mr. Marty Jakle (Partners for Fish and Wildlife, U.S. Fish and Wildlife Service)
Mr. Aaryn Olsson (University of Arizona School of Natural Resources, Arid Lands)
Mr. Todd Esque (U.S. Geological Survey)
Ms. Michelle Menchez (Arizona State Land Department)
Ms. Diana Rhoades (Sonoran Institute)
Ms. Julia Fonseca (Pima County Transportation and Flood Control District)
Ms. Jean Emery (Pima County Real Property Services)
Mr. Michael Bends (Tohono O'odham Nation, San Xavier District)
Mr. Barney Riley (Saguaro National Park)
Ms. Sarah Craighead (Saguaro National Park)
Mr. Noah Greenwald (Center for Biological Diversity)
Mr. Courtney Conway (University of Arizona)
Mr. Sam Drake (University of Arizona)

And any others who may have been inadvertently left off of the above lists.